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SOCIÉTÉ SUISSE DE ZOOLOGIE  
et du  
MUSÉUM D'HISTOIRE NATURELLE  
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# REVUE SUISSE DE ZOOLOGIE

TOME 112—FASCICULE 4

Publication subventionnée par:  
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VILLE DE GENÈVE  
SOCIÉTÉ SUISSE DE ZOOLOGIE

VOLKER MAHNERT  
Directeur du Muséum d'histoire naturelle de Genève

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## *Comité de lecture*

Il est constitué en outre du président de la Société suisse de Zoologie, du directeur du Muséum de Genève et de représentants des instituts de zoologie des universités suisses.

Les manuscrits sont soumis à des experts d'institutions suisses ou étrangères selon le sujet étudié.

La préférence sera donnée aux travaux concernant les domaines suivants: biogéographie, systématique, évolution, écologie, éthologie, morphologie et anatomie comparée, physiologie.

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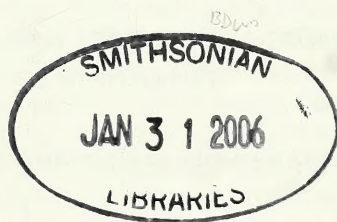
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## Additional notes on the fauna of Agromyzidae (Diptera) in Switzerland

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### Additional notes on the fauna of Agromyzidae (Diptera) in Switzerland.

- New faunistic data on the Swiss Agromyzidae are given. 144 species are recorded including 92 species found in Switzerland for the first time. Each species included is accompanied by information on its host plants and geographical distribution. The current list of the Swiss Agromyzidae thus embraces 232 species.

**Keywords:** Diptera - Agromyzidae - faunistics - biology - Switzerland.

### INTRODUCTION

The Agromyzidae, with its 1165 species described from the Palearctic Region (Scheirs *et al.*, 1999) and 843 species from Europe (Martinez, 1998) is one of the larger families of Diptera. The Swiss fauna of Agromyzidae is little studied with 140 recorded species in 19 genera (Martinez, 1998). On the other hand, the study of Agromyzidae in Europe and especially in the other countries of Central Europe is relatively advanced (cf. e.g. Griffiths, 1980; Nowakowski, 1973; Spencer, 1964, 1966, 1972b, 1976; Zlobin, 1992, 1993a, 1993b, 1993c, 1993d, 1994, 1995, 2003a, 2003b).

The following species were described directly from the territory of Switzerland (type locality in parentheses, abbreviation of cantons in following chapter): *Agromyza alnibetulae* Hendel, 1931 (type locality: Switzerland); *Chromatomyia gentianella* (Hendel, 1932) (Switzerland); *Ch. hoppiella* Spencer, 1990 (**GR**: Lenzerheide); *Liriomyza polygalae* Hering, 1927 (**TI**: Lugano); *Napomyza cichorii* Spencer, 1966 (**VS**: Orsières); *Phytobia mallochi* Hendel, 1924 (**GR**: Peist); *Phytomyza abdita* Hering, 1927 (**ZH**: Zürichberg); *P. alpestris* Hendel, 1920 (**GR**: St. Moritz); *P. hoppi* Hering, 1925 (**SG**: Pfäfers); *P. narcissiflorae* Hering, 1928 (**GR**: Parpan); *P. hoppiana* Hering, 1931 (**GR**: Zerneš) as a synonym of *P. pulsatiellae* Hering, 1924 (Spencer, 1976); *P. thalictri* Escher-Kündig in Rougemont, 1912 (Switzerland); *P. virgaureae* Hering, 1926 (**SZ**: Rigi); *P. thymi* Hering, 1928 (**GR**: Lenzerheide) and *Pseudonapomyza europaea* Spencer, 1973 (**VS**: Stalden). *P. atragenis* Hendel, 1931 (**GR**: Zerneš) and *P. philactaeae* Hering, 1932 (**GR**: Vals) were synonymized with *P. kaltenbachii* Hendel, 1922 (Hendel, 1931-6; Papp, 1984). *P. prenanthidis* Hering, 1932 (**SG**: Pfäfers) was synonymized with *P. sonchi* Robineau-Desvoidy, 1851 by Hendel (1931-6). Later Spencer (1965) synonymized *P. sonchi* with *P. marginella* Fallén, 1823.

The new *Material examined* by the author provided records on 144 species including 92 species which represent faunistic novelties for Switzerland. In total 232 species are now known from Switzerland representing 28% of the European fauna.

Agromyzids are mostly small to very small flies with a dark body sometimes showing a light metallic shine (*Melanagromyza* spp.), or a distinct yellow pattern (e.g. *Liriomyza* spp., *Phytoliriomyza* spp., *Cerodontha* spp.). The length of wings varies between 0.9 and 4.5 mm. The adult thorax is massive and the relatively broad abdomen consists of 6 visible segments. The eyes are broadly separated in both sexes, 1-2 rows of short orbital setulae are developed in addition to the regular orbital setae (except for *Selachops*).

Trophic preferences are phytophagous, larvae typically feed upon tissues of living plants and form characteristic mines. The larvae are cylindrical, slightly tapered on both ends, their body consists of the cephalic segment, 3 thoracic and 8 abdominal segments. The length of body varies between 1.5-3.0 mm but the body of *Phytobia* is unusually long, sometimes reaching 25 mm. Larvae of most species live in the parenchym of leaves, some mine the surface of stems. Larvae of *Phytobia* feed upon bast of some wood plants. *Hexomyza* larvae form galls on twigs of trees and bushes. Larvae of *Melanagromyza*, *Napomyza* and *Ophiomyia* (partially) live within stems and on roots of host plants. Some *Phytomyza* larvae are specialized for life in flowers.

Most Agromyzidae are oligophagous and their larvae prefer closely related species, genera or families of host plants. Some species are even monophagous and mine only one host plant. Only a relatively small group of agromyzids are widely polyphages and their spectrum of host plants includes numerous plants from many different families. *Chromatomyia horticola* (Goureau, 1851) may be mentioned as the best known and widely distributed polyphagous species mining a large series of plants.

A review of Central European agromyzids with a certain economic importance was published by Spencer (1973). Some species used to be included among serious pests of crops, e.g. *Liriomyza huidobrensis* (Blanchard, 1926) recorded also from Switzerland (Martinez, 1998). However, many species damage only the general or aesthetical appearance of plants, and economical losses are not too serious. More important economic losses are known only during the mass occurrence of some species living on cereals, (*Agromyza megalopsis* Hering, 1933 or *A. nigrella* [Rondani, 1875]), on Fabaceae and Brassicaceae (*Phytomyza rufipes* Meigen, 1830) and some ornamental plants (*Ch. horticola*, *L. huidobrensis*). Larvae of *Phytobia carbonaria* (Zetterstedt, 1848) bore the cambium of apple twigs.

The density of agromyzid populations is very often seriously influenced by hymenopteran parasites from families Braconidae, Chalcididae, Eulophidae and Ichneumonidae. The strictly monophagous species with their close relations to host plants may be used as suitable models for ecological research.

## MATERIAL AND METHODS

Species originating from Switzerland were found in the following collections:

CBM private collection Bohuslav Mocek, Hradec Králové, Czech Republic, 8 specimens.



- CMB** private collection Miroslav Barták, Praha, Czech Republic, 75 specimens. These specimens were collected with a Malaise Trap of the type M. Barták (Roháček *et al.*, 1998) above the tree line on 2000 m a.s.l. in the Alps of the Canton Graubünden.
- MHNG** Muséum d'histoire naturelle, Genève, Switzerland (Bernhard Merz), 284 specimens.
- ZMUC** Zoological Museum, University Copenhagen, Denmark (Rudolf Meier), 33 specimens.

Genera and species are arranged alphabetically in the two subfamilies Agromyzinae and Phytomyzinae. All relevant data from locality labels are included. Only selected important synonymy and new *References* (with regard to Switzerland) are quoted here, for full data see Martinez (1998), Papp (1984), Spencer & Martinez (1987) and Spencer (1990, 1992).

Nomenclature of Agromyzidae and plant names follow Spencer (1990).

The localities are grouped according to cantons (districts) of Switzerland and the following abbreviations are used: **AG** = Aargau; **BE** = Bern; **FR** = Fribourg; **GE** = Genève; **GL** = Glarus; **GR** = Graubünden (= Grisons); **JU** = Jura; **NE** = Neuchâtel; **SG** = St. Gallen; **SH** = Schaffhausen; **SZ** = Schwyz; **TI** = Ticino; **VD** = Vaud; **VS** = Valais; **ZH** = Zürich.

MT on locality labels means Malaise Trap.

The species which are new to Switzerland are marked with an asterisk (\*) before the name.

## LIST OF SPECIES

### Subfamily AGROMYZINAE

#### *Agromyza abiens* Zetterstedt, 1848

*Reference*: Martinez, 1998: 269.

*Material examined*: **GE**: Cartigny, Moulin de Vert, 350 m a.s.l., 1 ♀, 2.vi.2002. **GR**: Lenzerheide near Sanaspans, 1500 m a.s.l., 1 ♀, 7.viii.1992. **VS**: Leuk Bahnhof, 625 m a.s.l., 1 ♂, 15.v.2000. **ZH**: Zürich, 500 m a.s.l., 1 ♀, 10.viii.1991. All B. Merz leg. (MHNG).

*Notes*: This relatively large species with the orange frons and a broad epistoma was described from Sweden. *A. abiens* is generally distributed and locally common in Europe. Its occurrence in Japan was also confirmed. Larvae form broad leaf mines on Boraginaceae. Records include the genera *Anchusa*, *Asperugo*, *Borago*, *Cynoglossum*, *Echium*, *Lycopsis*, *Pentaglottis*, *Pulmonaria* and *Symphytum*.

#### *Agromyza albipennis* Meigen, 1830

*Reference*: Martinez, 1998: 269.

*Material examined*: **GE**: Chancy Bord du Rhône, 350 m a.s.l., 1 ♂, 28.vii.2002. B. Merz leg. (MHNG); Russin, Les Baillelets, 405 m a.s.l., 1 ♂, 1.vii.2002, B. Merz & Herrmann leg. (MHNG).

*Notes*: *A. albipennis* is a Holarctic species which is common in Europe, especially in its temperate and northern parts. It is less known from the Mediterranean area

(only Italy and Spain). Its occurrence in Japan, Kamchatka and North America (United States and Canada) is also documented. Larvae feed singly, forming linear-blotch mine on Gramineae, particularly on *Phalaris arundinacea*, less commonly on *Poa* and *Hordeum*, rarely on other grasses.

**\**Agromyza bicaudata* (Hendel, 1920)**

*Material examined:* **VS:** Leuk Pfynwald, 630 m a.s.l., 1 ♂, 21.iv.1998, B. Merz & Botta leg. (MHNG).

*Notes:* The type series includes localities in Germany and Austria. It is distributed in temperate Europe (Austria, British Isles, the Czech Republic, Germany, Hungary, Lithuania, Poland and Slovakia). Hendel (1931-6) mentioned this species from Finland and South Russia. This species is unusual in having a strongly developed presutural dc and specific male terminalia. Very probably a grass-feeder though its biology is not precisely known. New for Switzerland.

***Agromyza bromi* Spencer, 1966**

*Reference:* Martinez, 1998: 269.

*Material examined:* **VS:** Leuk Platten, 630 m a.s.l., 1 ♂, 22.iv.1998, B. Merz & B. Botta leg. (MHNG). **ZH:** Zürich Irchel, 500 m a.s.l., 1 ♂, 16.viii.1998, B. Merz leg. (MHNG).

*Notes:* The species is known from temperate Europe. The only recorded host is *Ceratochloa unioides* (= *Bromus catharticus*) but other grasses are doubtless also attacked.

**\**Agromyza cinerascens* Macquart, 1835**

*Material examined:* **GE:** Bernex, Signal, 510 m a.s.l., 1 ♂, 21.iii.1999; Chancy, La Laire, 350 m a.s.l., 1 ♂, 1.iv.2002; Russin, Les Baillets (Allondon), 390 m a.s.l., 1 ♂, 24.iii.2003. **ZH:** Zürich Albisgütli, 490 m a.s.l., 1 ♂, 9.iv.1997; Zürich Allmend, 440 m a.s.l., 1 ♀, 17.iv.1996. All B. Merz leg. (MHNG).

*Notes:* This Palearctic species was described from France; it is known from many countries of Europe (Austria, Belarus, Belgium, Croatia, the Czech Republic, Denmark, England, Estonia, Finland, Germany, Hungary, Italy incl. Sicily, Lithuania, the Netherlands, Norway, Poland, Romania, Slovakia, Spain, Russia, and Sweden), North Africa (Egypt and Tunisia) and Japan. Host plants are Gramineae, most frequently *Dactylis glomerata*, sometimes *Secale cereale*. New for Switzerland.

**\**Agromyza frontella* (Rondani, 1875)**

*Material examined:* **GE:** Bernex, Signal, 510 m a.s.l., 1 ♂, 8.vii.2001, B. Merz leg. (MHNG). **VS:** Leuk Brentjong, 920 m a.s.l., 1 ♂, 15.v.2000, B. Merz leg. (MHNG).

*Notes:* This Holarctic species was described from Italy (Parma). It is common in Austria, Belarus, the Czech Republic, Denmark, England, France, Germany, Hungary, Italy, Lithuania, Poland, Russia, Slovakia, Spain, Sweden, Canada, United States, Afghanistan, Israel, and Turkey. *A. frontella* belongs to the *Agromyza* species feeding on Leguminosae. The larva forms a characteristic mine on *Medicago sativa* and other *Medicago* spp., but also on *Melilotus*. New for Switzerland.



**\**Agromyza hendeli* Griffiths, 1963**

*Material examined:* **ZH:** Zürich Irchel, 500 m a.s.l., 1 ♂, 16.viii.1998, B. Merz leg. (MHNG).

*Notes:* *A. hendeli* is distributed in temperate Europe and known from Austria, Belgium, the Czech Republic, Denmark, England, Estonia, Germany, North Italy, Latvia, Lithuania, the Netherlands, Poland, Scotland and Slovakia. The larvae form a broad blotch mine on *Phragmites communis*. New for Switzerland.

**\**Agromyza idaeiana* Hardy, 1853**

*Material examined:* **GR:** San Vittore, Rebberg, 290 m a.s.l., 1 ♂, 8.iv.1997, B. Merz leg. (MHNG). **VS:** Leuk Platten, 625 m a.s.l., 1 ♂, 30.v.2002, B. Merz leg. (MHNG).

*Notes:* A Holarctic species known in the literature under the junior synonym *Agromyza potentillae* (Kaltenbach, 1864) (Bland, 2000). The species seems to be common in Europe (Austria, Belgium, the Czech Republic, England, Estonia, Finland, Germany, Hungary, Italy (Sardinia), Lithuania, the Netherlands, Norway, Poland, Russia, Slovakia, Spain, Sweden) as well as in Central and East Palaearctic (Uzbekistan, Kuril Islands and Japan). Largely distributed also in North America (Canada and United States). The larva forms a linear mine which later widens to a conspicuous blotch on Rosaceae (*Agrimonia*, *Alchemilla*, *Comarum*, *Filipendula*, *Fragaria*, *Geum*, *Potentilla*, *Rosa*, *Rubus* and *Sanguisorba*). New for Switzerland.

**\**Agromyza lucida* Hendel, 1920**

*Material examined:* **GE:** Cartigny, Moulin de Vert, 350 m a.s.l., 1 ♂, 9.vii.2002, B. Merz leg. (MHNG).

*Notes:* *A. lucida* is known from the Holarctic Region and distributed especially in Europe (Austria, the Czech Republic, Denmark, England, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, the Netherlands, Poland, Russia, Scotland, Slovakia, Spain, Sweden) and North America (Canada). Its occurrence is also confirmed in India. The larvae form a broad blotch mine on Gramineae, known foodplants are *Glycera maxima* and *Deschampsia caespitosa*. New for Switzerland.

**\**Agromyza marionnae* Griffiths, 1963**

*Material examined:* **ZH:** Zürich Albisgütli, 500 m a.s.l., 1 ♂, 2.iv.1997, B. Merz leg. (MHNG).

*Notes:* The species was described from England and later recorded from Germany, Ireland, Lithuania and Spain. According to Pakalniškis (1996) the larva mines stems of *Vicia cracca* and *V. tetrasperma* at borders of mixed forest and in urban cenoses. New for Switzerland.

***Agromyza mobilis* Meigen, 1830**

*Reference:* Martinez, 1998: 269.

*Material examined:* **GE:** Bernex Chante Merle, 420 m a.s.l., 1 ♂, 7.viii.2000, B. Merz & G. Bächli leg. (MHNG). **GR:** Zerne, Gondas, 1480 m a.s.l., 1 ♂, 8.viii.1996, B. Merz & G. Bächli leg. (MHNG). **SH:** Borgen-Mülital, 650 m a.s.l., 1 ♂,

28.viii.1992, B. Merz leg. (MHNG). **TI**: Gordola, 210 m a.s.l., 1 ♂, 14.ix.1989, B. Merz leg. (MHNG). **ZH**: Zürich Irchel, 500 m a.s.l., 1 ♂, 24.v.1996, B. Merz leg. (MHNG).

*Notes*: *A. mobilis* is a species with a Palaearctic distribution, known to occur especially in Europe but also in China and Japan. It occurs namely in countries of temperate and northern Europe. In the Mediterranean area it was recorded only from Italy, Spain and the former Yugoslavia. *Triticum* represents the only confirmed known host plant but the larvae mine very probably also other species of Graminae.

### ***Agromyza nana* Meigen, 1830**

*Reference*: Martinez, 1998: 269.

*Material examined*: **GR**: Lenzerheide, 2000 m a.s.l., 1 ♂, 14.-21.vii.2000, 2 ♂♂, 23.-31.viii.2000, pasture, MT, B. Merz leg. (CMB). **SH**: Merishausen, Ladel, 700 m a.s.l., 1 ♂, 13.v.1991, B. Merz leg. (MHNG). **VS**: Eggerberg, 850 m a.s.l., 1 ♂, 24.vi.2000, B. Merz leg. (MHNG); Visperterminen Rothorn, 2250 m a.s.l., 1 ♂, 26.viii.2001, B. Merz & Landry leg. (MHNG); Saas-Fee, 2400 m a.s.l., 1 ♂, 22.vii.1965, 2 ♂♂, 23.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes*: The Palaearctic *A. nana* belong to the species of the *orobi*-group (Zlobin, 2000), which live in Leguminosae (*Medicago sativa*, *Trifolium*, *Melilotus*). With its morphology and the structure of male genitalia it is very similar to other species of this group, especially to *A. frontella* (Rondani, 1875), but stridulation border is species-specific (Tschirnhaus, 1971). Generally common in the Palaearctic Region including Egypt, Morocco, Tunisia, Turkey and eastern Siberia. Also recorded from India.

### ***Agromyza nigripes* Meigen, 1830**

*References*: Griffiths, 1963: 132; Martinez, 1998: 269.

*Material examined*: **GE**: Jussy, Prés-de-Villette, 475 m a.s.l., 1 ♂, 2.viii.2002, B. Merz leg. (MHNG). **ZH**: Zürich Albisgütli, 470 m a.s.l., 1 ♂, 19.viii.1997, B. Merz & Botta leg. (MHNG); Zürich Hönggerberg, 600 m a.s.l., 1 ♂, 18.vi.1992, B. Merz leg. (MHNG); Zürich Zürichberg, 650 m a.s.l., 1 ♂, 26.vii.1995, S. Ungricht leg. (MHNG).

*Notes*: The species is known mainly from the Holarctic Region, (Europe and Canada), but it is also recorded from the Oriental Region (India). The larva forms a long, widening mine on the upper leaf surface of *Glyceria maxima* and the species also commonly occurs on *Holcus*.

### ***Agromyza polygoni* Hering, 1941**

*Reference*: Martinez, 1998: 269.

*Material examined*: **GR**: Zuoz, Nüd, 1700 m a.s.l., 1 ♂, 7.viii.1996, B. Merz & G. Bächli leg. (MHNG).

*Notes*: The species was described from Germany and recently it was also recorded from the Czech Republic, France, Lithuania, Poland and Switzerland. The larva forms on *Polygonum bistorta* an irregular linear-blotch mine, which is not associated to the midrib.

### **\**Agromyza prespana* Spencer, 1957**

*Material examined*: **TI**: Gordola, Bolle di Magadino, Zeltfalle, 220 m a.s.l., 1 ♂, 19.vi.1995, B. Merz & G. Bächli leg. (MHNG).



*Notes:* Spencer (1957) described this species from Macedonia. It is also known from Austria, British Isles, Croatia (Dalmatia), the Czech Republic, France, Hungary, Poland, Slovakia and Sweden. The larva forms a broad mine on *Triticum aestivum* and other grasses. New for Switzerland.

**\**Agromyza pseudoreptans* Nowakowski, 1967**

*Material examined:* **GE:** Chancy, La Laiterie, 350 m a.s.l., 1 ♂, 1.vii.2001; Dardagny, Roulave, 420 m a.s.l., 1 ♂, 30.vi.2001. **GR:** Valbella, Casoja, 1550 m a.s.l., 1 ♂, 13.vii.1996. **SH:** Merishausen-Ladel, 600 m a.s.l., 1 ♀, 28.vii.1992. **ZH:** Flaach, Thurauen, 350 m a.s.l., 1 ♀, 1.ix.1993; Zürich Waldgarten, 450 m a.s.l., 2 ♂♂, 24.v.1996; 460 m a.s.l., 1 ♂, 1.v.1997. All B. Merz leg. (MHNG).

*Notes:* This Holarctic species is common in Austria, Belgium, Canary Islands, the Czech Republic, Denmark, England, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, the Netherlands, Norway, Poland, Russia, Scotland, Slovakia, Sweden and North America (Canada and United States, incl. Alaska). The larva forms elongate linear-blotch mine, normally adjoining margin of leaves of *Urtica dioica*. New for Switzerland.

**\**Agromyza pseudorufipes* Nowakowski, 1964**

*Material examined:* **GR:** Valbella, Casoja, 1550 m a.s.l., 1 ♂, 13.vii.1996, B. Merz leg. (MHNG).

*Notes:* The species was described from Poland and reliable records are known from the Czech Republic, England, Germany, Lithuania, Poland, Romania, Slovakia and Japan. New for Switzerland.

**\**Agromyza quadriseta* Zlobin, 2001**

*Material examined:* **GE:** Bernex, Signal, 510 m a.s.l., 1 ♂, 24.v.2002. **ZH:** Embrach, Haumüli, 430 m a.s.l., 1 ♂, 29.v.1998, B. Merz leg. (MHNG).

*Notes:* This species was recently described from Estonia, Lithuania, Finland and Russia (holotype). *A. quadriseta* belongs to the large group of Palaearctic species having long presutural dorsocentrals and the costal vein strongly extending to  $M_{1+2}$ . Biology of this species is unknown. New for Switzerland.

**\**Agromyza rondensis* Strobl, 1900**

*Material examined:* **GE:** Cartigny, Moulin de Vert, 350 m a.s.l., 1 ♂, 4.v.2003, B. Merz & M. Eggenberger leg. (MHNG).

*Notes:* The species was described from Spain and later on recorded in other countries of West Palaearctic (Austria, Belarus, Belgium, Canary Islands, Crete, Croatia, the Czech Republic, England, Estonia, France, Germany, Hungary, Italy, Lithuania, Norway, Poland, Portugal, Romania, Scotland, Slovakia, Sweden and Turkey). The larva forms a leaf mine on Gramineae (*Arrhenatherum*, *Bromus*, *Calamagrostis*, *Dactylis*, *Hordeum*, *Poa*, *Secale* and *Triticum*). New for Switzerland.

***Agromyza sulfuriceps* Strobl, 1898**

*Reference:* Martinez, 1998: 269.

*Material examined:* **VS:** Saas-Fee, 2400 m a.s.l., 1 ♂, 22.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes:* This small species with yellow frons and bright yellow antennae is known especially from the Holarctic Region but also recorded from tropical Africa (Nigeria). Host plants of this species are *Potentilla* and *Sanguisorba*. The larva forms a narrow upper surface gallery to start, then broadening and zigzagging to create a false blotch.

**\**Melanagromyza astragali* Spencer, 1976**

*Material examined:* **SZ:** Brunni, 900 m a.s.l., 1 ♂, 26.vi.1990, B. Petersen leg. (ZMUC). **VS:** Leuk Brentjong, 930 m a.s.l., 1 ♂, 3.v.1990, 900 m a.s.l., 1 ♂, 1.vi.1991, B. Merz leg. (MHNG).

*Notes:* This species was described by Spencer (1976) from Sweden from stems of *Astragalus glycyphyllus* and later on it was recorded from other countries of Europe (Czech Republic, France, Germany, Lithuania and Slovakia). New for Switzerland.

***Melanagromyza cunctans* (Meigen, 1830)**

*Reference:* Martinez, 1998: 269.

*Material examined:* **VS:** Visperterminen Dorf, 1400 m a.s.l., 1 ♂, 26.viii.2001, B. Merz & Landry leg. (MHNG). **ZH:** Zürich Irchel, 500 m a.s.l., 1 ♂, 16.viii.1998, B. Merz leg. (MHNG).

*Notes:* The species was described from Spain and its known distribution area includes other countries of temperate Europe and Scandinavia (Sweden) but it seems to be more common in the Mediterranean area (Canary Islands, Corsica, Crete, Croatia, Egypt, Italy, Maltese Islands and Turkey) and the Afrotropical Region (including Madagascar). Its occurrence was also confirmed in Central Palaearctic (Uzbekistan) and the Oriental Region (India). The larva forms a slender stem-gall on *Lotus corniculatus* (Leguminosae).

**\**Ophiomyia aeneonitens* (Strobl, 1893)**

*Material examined:* **VS:** Leuk Pfynwald, 600-650 m a.s.l., 1 ♂, 15.v.1996, B. Merz & G. Bächli leg. (MHNG).

*Notes:* The sole member of the genus with typically white squamae and fringes, and lacking the posterior crossvein on the wing. This is the second record of this species in Europe. It was described from a warm area of Austria. Biology of this species is not known. New for Switzerland.

**\**Ophiomyia campanularum* Starý, 1930**

*Material examined:* **NE:** St. Blaise, Les Riedes, 470 m a.s.l., 1 ♂, 19.v.2001, B. Merz leg. (MHNG).

*Notes:* This species was described from the the Czech Republic and now it is known only from Germany, Slovakia and Sweden. The larva forms an external stemmine with frass in large, widely-spaced grains on *Campanula rotundifolia*. New for Switzerland.

**\**Ophiomyia cunctata* (Hendel, 1920)**

*Material examined:* **ZH:** Zürich Oerlikon, 420 m a.s.l., 1 ♀, vi.-x.1987, B. Merz leg. (MHNG).



*Notes:* Widespread throughout much of Europe (Albania, Austria, Canary Islands, the Czech Republic, Denmark, England, Finland, France, Germany, Hungary, Italy, Lithuania, Norway, Poland, Russia, Scotland, Spain, Sweden, Turkey and the former Yugoslavia). The larva forms a whitish blotch mine along the midrib, with irregular offshoots into the leaf-blade on *Crepis*, *Hypochoeris*, *Lapsana*, *Mycelis*, *Picris*, *Sonchus* and *Taraxacum*. New for Switzerland.

***Ophiomyia curvipalpis* (Zetterstedt, 1848)**

*Reference:* Martinez, 1998: 269.

*Material examined:* **GE:** Bernex, Signal, 510 m a.s.l., 1 ♂, 24.v.2002, B. Merz leg. (MHNG); Corsier-Port, 1 ♀, 16.-31.viii.2003, C. Besuchet leg. (MHNG). **TI:** Biasca Loderio, 300 m a.s.l., 1 ♂, 5.vii.1991, B. Merz leg. (MHNG). **VS:** Leuk Pfynwald, 680 m a.s.l., 1 ♀, 7.vi.2001, B. Merz & Landry leg. (MHNG); Leuk Platten, 625 m a.s.l., 1 ♂, 2.v.1999, B. Merz leg. (MHNG); St. German, Brücke, 624 m a.s.l., 1 ♂, 3.viii.1998, B. Merz & G. Bächli leg. (MHNG).

*Notes:* This species is distributed chiefly in the West Palearctic but it is also known from Japan. The larva forms a narrow, inconspicuous stem-mine on *Achillea millefolium*, *A. ptarmica*, *Anthemis tinctoria*, *Artemisia vulgaris*, *Matricaria inodora*, and possibly also on *Medicago sativa*.

**\**Ophiomyia galii* Hering, 1937**

*Material examined:* **VS:** Visperterminen, Kreuz, 1400 m a.s.l., 1 ♂, 3.vi.2003, B. Merz leg. (MHNG).

*Notes:* The species was recorded from Corsica, the Czech Republic, England, France, Germany, Lithuania, Poland, Slovakia, and Spain. *O. galii* was described from Germany, and the type series was reared from *Galium mollugo*. The larva forms an external stem mine, with frass in large, widely spaced grains. According to Pakalniškis (1998b) it may also attack *G. verum*. New for Switzerland.

**\**Ophiomyia inaequalis* (Hendel, 1931)**

*Material examined:* **VS:** Leuk Pfynwald, 600 m a.s.l., 1 ♂, 2.vii.2001, B. Merz leg. (MHNG).

*Notes:* This Mediterranean species was described from a single male originating from Turkey; later it was also recorded from the Czech Republic. Our record represents the westernmost boundary of the distribution area in Europe. Its biology is unknown. New for Switzerland.

***Ophiomyia nasuta* (Melander, 1913)**

*Reference:* Martinez, 1998: 269.

*Material examined:* **SH,** Merishausen, Ladel, 600 m a.s.l., 1 ♂, 28.iii.1992, B. Merz leg. (MHNG).

*Notes:* This species occurs in the Holarctic Region. It is known especially from temperate and northern Europe, North America (Canada, United States) and Japan. Its only known host plant genus is *Taraxacum* sp.

***Ophiomyia orbiculata* (Hendel, 1931)**

*References:* Spencer, 1964: 800; Martinez, 1998: 269.

*Material examined:* **GE:** Bernex, Signal, 510 m a.s.l., 1 ♂, 24.v.2002, B. Merz leg. (MHNG). **NE:** St. Blaise Les Riedes, 470 m a.s.l., 2 ♂♂, 19.v.2001, B. Merz leg. (MHNG). **VS:** Leuk Pfywald, 600-650 m a.s.l., 1 ♂, 15.v.1996, B. Merz & G. Bächli leg. (MHNG); Leuk Platten, 630 m a.s.l., 1 ♂, 22.iv.1998, B. Merz & Botta leg. (MHNG).

*Notes:* The species was described from Austria based on two males and its distribution area includes mainly temperate and northern Europe. In the Mediterranean area it is known only from the former Yugoslavia and Turkey. The larva feeds as a stem-miner on *Pisum sativum*, and probably also on *Vicia*.

***Ophiomyia pinguis* (Fallén, 1820)**

*References:* Spencer, 1973: 140; Martinez, 1998: 269.

*Material examined:* **GR:** Valbella Casoja, 1500 m a.s.l., 1 ♂, 19.vii.1997, B. Merz leg. (MHNG). **VS:** Saas-Fee, 2300 m a.s.l., 1 ♂, 1 ♀, 19.vii.1965, 1800 m a.s.l., 1 ♀, 21.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes:* *O. pinguis* is known to occur in the Palaearctic Region. The species is recorded from European countries including the Mediterranean area (Italy, Spain and the former Yugoslavia). It is also confirmed from Egypt and Turkey and penetrates through Tajikistan and Uzbekistan to China. The natural hosts of this species are *Cichorium intybus*, *C. endivia*, *Lactuca sativa* and *Leontodon*.

**\**Ophiomyia submaura* Hering, 1926**

*Material examined:* **GR:** Ardez, Bahnhof, 1350 m a.s.l., 1 ♂, 6.viii.1996, B. Merz & G. Bächli leg. (MHNG).

*Notes:* *O. submaura* occurs in the West Palaearctic. It is confirmed from the Czech Republic, Germany, Hungary, Lithuania, Poland, Spain and Turkey. Pakalniškis (1996) reared it from *Medicago falcata* at borders of mixed forests and in brighter pine woods. New for Switzerland.

**\**Ophiomyia vimmeri* Černý, 1994**

*Material examined:* **GR:** Valbella, Casoja, 1500 m a.s.l., 1 ♂, 14.vii.1998, B. Merz leg. (MHNG).

*Notes:* *O. vimmeri* was described from the Czech Republic, it is also known to occur in Slovakia. Its biology is unknown. New for Switzerland.

**Subfamily PHYTOMYZINAE**

**\**Amauromyza (Cephalomyza) flavifrons* (Meigen, 1830)**

*Material examined:* **SH:** Rüdlingen, 370 m a.s.l., 1 ♂, 7.ix.1996, B. Merz leg. (MHNG). **TI:** Gordola, Bolle, 220 m a.s.l., 1 ♂, 1.viii.1993, B. Merz & M. - Eggenberger leg. (MHNG). **ZH:** Zürich Oerlikon, 430 m a.s.l., 1 ♂, 23.v.1992, B. Merz leg. (MHNG).

*Notes:* This Holarctic species is distributed in Alabania, Austria, Belgium, Corsica, the Czech Republic, Denmark, England, Finland, France, Germany, Hungary, Kyrgyzstan, Lithuania, the Netherlands, Norway, Poland, Romania, Sardinia, Scotland, Spain, Sweden, Turkey and North America (Canada and United States). The larva



forms a white linear-blotch mine on many genera of Caryophyllaceae, particularly on *Dianthus*, *Lachnis*, *Melandrium*, *Saponaria*, *Silene*, *Stellaria* but also on *Beta vulgaris* and *Spinacia oleracea* (Chenopodiaceae). New for Switzerland.

**\**Amauromyza (Cephalomyza) mihalyii* Spencer, 1971**

*Material examined:* **NE:** St. Blaise, Les Riedes, 470 m a.s.l., 2 ♂♂, 19.v.2001, B. Merz leg. (MHNG).

*Notes:* This species was described from Hungary and later recorded from the Czech Republic. This record is a further evidence of *A. (C.) mihalyii* in Central Europe and represents the westernmost boundary of its occurrence. Its biology is unknown. New for Switzerland.

***Amauromyza (Cephalomyza) monfalconensis* (Strobl, 1909)**

*References:* Spencer, 1992: 142; Martinez, 1998: 269.

*Material examined:* **GR:** Lenzerheide Sundroina, 1600 m a.s.l., 1 ♂, 16.vii.2000, B. Merz leg. (MHNG).

*Notes:* This species is distributed especially in temperate Europe. It is also recorded from Scandinavia (Sweden) and some countries of the Mediterranean area (Italy and Spain). Host plants and immature stages unknown; larva almost certainly feeds as internal stem-borer.

**\**Aulagromyza luteoscutellata* (de Meijere, 1924)**

*Material examined:* **VS:** Leuk Pfynwald, 600 m a.s.l., 1 ♂, 25.viii.2001, B. Merz & Landry leg. (MHNG).

*Notes:* The species is distributed in temperate and northern Europe (Belgium, the Czech Republic, Denmark, Finland, France, Germany, Lithuania, the Netherlands, Norway, Poland, Sweden) and Canada. It has not been recorded from the Mediterranean area, but it is known from India. The larva forms a short, funnel-shaped leaf mine; filled centrally with dark-green frass on *Lonicera* and *Symphoricarpos*. New for Switzerland.

**\**Aulagromyza orphana* (Hendel, 1920)**

*Material examined:* **ZH:** Zürich Katensee, 440 m a.s.l., 1 ♂, 25.v.1999, B. Merz leg. (MHNG).

*Notes:* Locally distributed particularly in Central Europe. Its occurrence is confirmed for Austria, Belgium, the Czech Republic, Denmark, England, France, Germany, Hungary, the Netherlands, Poland, Scotland, Slovakia, Spain and Turkey. The larva forms an external stem mine on *Galium aparine*, probably also on *G. palustre*. New for Switzerland.

**\**Aulagromyza similis* (Brischke, 1880)**

*Material examined:* **SH:** Merishausen, 550 m a.s.l., 1 ♀, 26.iv.1990, B. Merz leg. (MHNG).

*Notes:* A European species occurring in Austria, the Czech Republic, England, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Norway, Poland, Romania, Sweden and Wales. The larva forms a large whitish linear blotch leaf mine,

frequently associated with the midrib on *Knautia arvensis* and *Succisa pratensis*. New for Switzerland.

***Aulagromyza trivittata* (Loew, 1873)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **ZH:** Zürich Albisgütli, 490 m a.s.l., 1 ♂, 9.iv.1997, B. Merz leg. (MHNG).

*Notes:* This species is distributed mainly in temperate Europe. In Scandinavia it is recorded from Norway and Sweden. It is not known from the Mediterranean area. The larva feeds as internal stem borer on *Galium mollugo*.

***Calycomyza humeralis* (von Roser, 1840)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 3 ♂♂, viii.2000, pasture, MT, B. Merz leg. (CMB). **VS:** Leuk Platten, 630 m a.s.l., 1 ♂, 22.iv.1998, B. Merz & Botta leg. (MHNG); Visperterminen Giw-Gebidemsee, 1900-2200 m a.s.l., 1 ♂, 28.viii.2001, B. Merz & Landry leg. (MHNG).

*Notes:* A semicosmopolitan species which is locally distributed in Europe but also known from East Palaearctic, North and South America, the Afrotropical and the Oriental Regions, Australia and the Hawaiian Islands. The larva forms a leaf mine on *Aster*, *Bellis* and *Erigeron*.

**\**Cerodontha (Butomomyza) angulata* (Loew, 1869)**

*Material examined:* **ZH:** Zürich Zürichberg, 500-600 m a.s.l., 3 ♂♂, 16.viii.1992, B. Merz leg. (MHNG).

*Notes:* The species is distributed in the Holarctic Region including Japan and Kuril Islands. The larva forms a long greenish leaf mine on *Carex*, rarely on *Scirpus silvaticus*. New for Switzerland.

**\**Cerodontha (Butomomyza) rohdendorfi* Nowakowski, 1967**

*Material examined:* **ZH:** Embrach, Haumüli, 400 m a.s.l., 1 ♂, 28.v.1997, B. Merz leg. (MHNG).

*Notes:* Described from Poland and later recorded from the Czech Republic, Finland and Italy. The larva forms an upper or lower surface mine, filling the entire width of the leaf of *Poa chaixii*, *Festuca pratensis* and probably other related grasses. New for Switzerland.

***Cerodontha (Cerodontha) affinis* (Fallén, 1823)**

*References:* Spencer, 1976: 177; Martinez, 1998: 270.

*Material examined:* **ZH:** Horgen, 550 m a.s.l., 1 ♂, 24.v.1989, B. Merz leg. (MHNG).

*Notes:* The species is common in Europe, particularly in the temperate zone. Its biology is unknown.

***Cerodontha (Cerodontha) denticornis* (Panzer, 1806)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **GR:** Lenzerheide, 1600 m a.s.l., 1 ♀, 8.x.1991, B. Merz & M. Eggenberger leg. (MHNG); Lenzerheide, 2000 m a.s.l., 1 ♂, 23.viii.-9.ix.2000,



pasture, MT, B. Merz leg. (CMB). **SH**: Merishausen, Gräte, 520 m a.s.l., 1 ♂, 1.vi.1996, B. Merz & M. Eggenberger leg. (MHNG). **VS**: Saas-Fee, 1800 m a.s.l., 1 ♂, 3 ♀♀, 21.vii.1965, O. Lomholdt leg. (ZMUC). **TI**: Lavertezzo, 560 m a.s.l., 1 ♀, 12.ix.1989, B. Merz leg. (MHNG). **ZH**: Zürich Allmend, 460 m a.s.l., 2 ♂♂, 17.v.1995; Zürich Irchel, 500 m a.s.l., 1 ♂, 24.v.1996; Zürich Katzenssee, 440 m a.s.l., 1 ♂, 25.v.1996, B. Merz leg. (MHNG).

*Notes*: A common Palaearctic species described from Germany. Known to occur also in the Afrotropical and Oriental Regions including Taiwan. The larva feeds mainly in the leaf sheath of Gramineae.

***Cerodontha (Cerodontha) fulvipes* (Meigen, 1830)**

*References*: Spencer, 1976: 177, 180; Martinez, 1998: 270.

*Material examined*: **GL**: Pragelpass, 1500 m a.s.l., 1 ♂, 5.viii.1991, G. Bächli, Beuk & B. Merz leg. (MHNG). **GR**: Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB). **TI**: Gordola, Bolle d. M., 205 m a.s.l., 2 ♂♂, 6.vii.2001, B. Merz leg. (MHNG). **VS**: Baltschieder, Rotten-Ufer, 650 m a.s.l., 1 ♂, 19.v.1996, B. Merz leg. (MHNG); Saas-Fee, 2000 m a.s.l., 1 ♂, 1 ♀, 18.vii.1965, 2300 m a.s.l., 2 ♀♀, 19.vii.1965, 1800 m a.s.l., 1 ♀, 21.vii.1965, O. Lomholdt leg. (ZMUC). **ZH**: Embrach Haumüli, 400 m a.s.l., 3 ♂♂, 24.vi.1995, 1 ♂, 19.vi.1998, Zürcher leg. (MHNG); Zürich Irchel, 500 m a.s.l., 1 ♂, 16.viii.1998, B. Merz leg. (MHNG).

*Notes*: A Palaearctic species which is generally distributed in Europe and recorded also from China. *Poa trivialis* is known as a host plant but the larva feeds probably on other grasses as well.

**\**Cerodontha (Cerodontha) unguicornis* Hendel, 1932**

*Material examined*: **GR**: Lenzerheide, 2000 m a.s.l., 1 ♂, 23.-31.viii.2000, pasture, MT, B. Merz leg. (CMB); Valbella, Casoja, 1600 m a.s.l., 1 ♀, 18.vii.2000, B. Merz leg. (MHNG). **VS**: Saas-Fee, 1800 m a.s.l., 1 ♂, 21.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes*: The species was described from Central Europe. It is known from Austria, the Czech Republic and Germany. Its biology is still unknown. New for Switzerland.

**\**Cerodontha (Dizygomyza) bimaculata* (Meigen, 1830)**

*Material examined*: **BE**: Tramelan, La Tourbière, 995 m a.s.l., 1 ♂, 4.vi.2003, Merz, Haenni & Rapp leg. (MHNG). **GR**: S. Vittore, Rebberg, 300 m a.s.l., 1 ♂, 4.viii.1997, B. Merz leg. (MHNG). **TI**: Biasca, 350 m a.s.l., 1 ♂, 18.v.1991, B. Merz leg. (MHNG); Mte. Caslano, 400 m a.s.l., 1 ♂, 20.v.1991, B. Merz leg. (MHNG). **VS**: Morgins, Portes du Soleil (Monthey), 1700-1950 m a.s.l., 1 ♂, 22.vi.2003, B. Merz leg. (MHNG).

*Notes*: This species is common in Europe. It is also known from the Kuril Islands and Japan. The larva forms a narrow mine on *Luzula*, particularly on *L. pilosa*. New for Switzerland.

**\**Cerodontha (Dizygomyza) crassiseta* (Strobl, 1900)**

*Material examined*: **GR**: Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* A European species which is distributed especially in temperate Europe. In Fennoscandia known only from Sweden, and in the Mediterranean area recorded only from Italy and Spain. *Dactylis glomerata* and *Poa compressa* are known as host plants of this species. New for Switzerland.

**\**Cerodontha (Dizygomyza) fasciata* (Strobl, 1880)**

*Material examined:* VS: Leuk Pfynwald, 630 m a.s.l., 1 ♂, 21.iv.1998, B. Merz & Botta leg. (MHNG); Visperterminen Dorf, 1400 m a.s.l., 1 ♂, 26.viii.2001, B. Merz & Landry leg. (MHNG).

*Notes:* A species with a Holarctic type of distribution, known from temperate and northern Europe. It has not been recorded from the Mediterranean area. In North America occurring in Canada and the United States. Its biology is unknown. New for Switzerland.

**\**Cerodontha (Dizygomyza) griffithsi* Nowakowski, 1967**

*Material examined:* VS: Saas-Fee, 2000 m a.s.l., 1 ♂, 22.vii.1965, 1 ♂, 27.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes:* This species was described from one male originating from the Austrian Alps. Later it was found in France. Its discovery in the Swiss Alps is thus not surprising. Recently it was captured in the High Tatra Mts in Slovakia (Černý & Vála, 2005). Its biology is unknown. New for Switzerland.

**\**Cerodontha (Dizygomyza) luctuosa* (Meigen, 1830)**

*Material examined:* GR: Zernez, Gondas, 1480 m a.s.l., 1 ♂, 4.viii.1996, B. Merz & G. Bächli leg. (MHNG).

*Notes:* The species occurs in the Holarctic Region. It is known particularly from Europe, but also from Tunisia, China, Japan and North America (Canada, United States, incl. Alaska). The larva feeds on *Juncus effusus*. New for Switzerland.

**\**Cerodontha (Dizygomyza) luzulae* (Groschke, 1957)**

*Material examined:* ZH: Zürich Albisgütli, 450 m a.s.l., 1 ♂, 1.v.1995, B. Merz leg. (MHNG).

*Notes:* This European species was recorded from some Central European countries (the Czech Republic, Germany, Hungary and Poland) and the British Isles. *Luzula sylvatica* is the only known host plant of *C. (D.) luzulae*. New for Switzerland.

***Cerodontha (Dizygomyza) morosa* (Meigen, 1830)**

*References:* Hendel, 1931-6: 92; Martinez, 1998: 270.

*Material examined:* GR: S. Vittore Rebberg, 300 m a.s.l., 1 ♂, 4.viii.1997, B. Merz leg. (MHNG).

*Notes:* This Holarctic species is common in Europe and known to occur also in the East Palaearctic (China and Japan) and the Oriental Regions (Philippines). The larva forms a relatively short and broad mine, which not extends to the leaf base of *Carex*.

**\**Cerodontha (Dizygomyza) spinata* (Groschke, 1954)**

*Material examined:* VS: Visperterminen Rothorn, 2250 m a.s.l., 2 ♂♂, 26.viii.2001, B. Merz & Landry leg. (MHNG).



*Notes:* The species is known from Austria, the British Isles, the Czech Republic, Germany and Poland. The larva feeds on *Carex sylvatica* and *C. pilosa*. New for Switzerland.

**\**Cerodontha (Poemyza) alpina* Nowakowski, 1967**

*Material examined:* **GR:** Lenzerheide, St. Cassian, 1450 m a.s.l., 1 ♂, 12.vii.1998, B. Merz leg. (MHNG).

*Notes:* This mountain species was described from the upper forest zone of the East Carpathians (Poland) and later it was found in Austria. Our record of *C. (P.) alpina* in the Swiss Alps could be expected. The larva forms a leaf mine on *Poa alpina* and *Trisetum alpestre*. New for Switzerland.

***Cerodontha (Poemyza) atra* (Meigen, 1830)**

*References:* Hendel, 1931-6: 38; Nowakowski, 1973: 91; Martinez, 1998: 270.

*Material examined:* **GE:** Bernex, Signal, 510 m a.s.l., 1 ♂, 24.v.2002, B. Merz leg. (MHNG).

*Notes:* This species is common in Europe and known to occur in Japan. Some species of Gramineae are host plants of this species, in particular *Calamagrostis epigeios* and *Agrostis alba*.

**\**Cerodontha (Poemyza) beigeriae* Nowakowski, 1973**

*Material examined:* **GE:** Russin, Les Baillets, 405 m a.s.l., 1 ♂, 30.vi.2001, B. Merz leg. (MHNG).

*Notes:* Originally known only from Central Europe (the Czech Republic, Germany, Hungary and Poland). Recently Zlobin (1986, 1992) recorded *C. (P.) beigeriae* also from East Siberia and the Far East. The larva feeds on *Calamagrostis canescens*, *C. arundinacea*, *C. villosa* and *Agrostis canina*. New for Switzerland.

**\**Cerodontha (Poemyza) calamagrostidis* Nowakowski, 1967**

*Material examined:* **GE:** Bernex, Chante-Merle, 415 m a.s.l., 1 ♂, 20.v.2002, B. Merz leg. (MHNG).

*Notes:* This Holarctic species is distributed in Europe but it has not been found in the Mediterranean area. In North America known from Canada. *Calamagrostis* sp. and *Alopecurus pratensis* are the known host plants. New for Switzerland.

**\**Cerodontha (Poemyza) incisa* (Meigen, 1830)**

*Material examined:* **ZH:** Zürich Zürichberg, 450-650 m a.s.l., 1 ♂, 20.viii.1992, B. Merz leg. (MHNG).

*Notes:* This Holarctic species is common in Europe but also known from China, Pakistan, Japan and North America. The larva forms a leaf mine on Gramineae, most commonly on *Agropyron*, *Calamagrostis*, *Festuca* and *Phalaris* but Nowakowski (1973) recorded 17 additional European genera. New for Switzerland.

**\**Cerodontha (Poemyza) lateralis* (Macquart, 1835)**

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, 23.-31.viii.2000, pasture, MT, B. Merz leg. (CMB). **VS:** Branson, Follatères, 450-950 m a.s.l., 1 ♂, 29.iii.2002; Leuk Pfynwald, 630 m a.s.l., 1 ♂, 25.v.1997, 600 m a.s.l., 1 ♂, 2.vii.2001. All B. Merz leg. (MHNG).

*Notes:* This Palaearctic species is common in the whole of West Palaearctic and penetrates to North Africa (Tunisia), Turkey, China and Japan. The larva forms a linear mine running towards the apex of the leaf and this can widen and become almost blotch-like on Gramineae. New for Switzerland.

**\**Cerodontha (Poemyza) lyneborghi* Spencer, 1972**

*Material examined:* **GE:** Chancy, La Laire, 350 m a.s.l., 1 ♂, 24.iv.2003, B. Merz & F. Amiet leg. (MHNG); **Russin,** Les Bailleys, 405 m a.s.l., 1 ♂, 30.vi.2001, B. Merz leg. (MHNG).

*Notes:* This species was described by Spencer (1972a) from Spain and later on it was found in other countries of Europe (the Czech Republic, Hungary, Italy, Lithuania and Russia). Its biology is unknown. New for Switzerland.

***Cerodontha (Poemyza) muscina* (Meigen, 1830)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 2 ♂♂, viii.2000, pasture, MT, B. Merz leg. (CMB); Lenzerheide, gegen Sanaspans, 1500 m a.s.l., 1 ♂, 7.viii.1992, B. Merz leg. (MHNG). **VS:** Visperterminen Dorf, 1400 m a.s.l., 1 ♂, 26.viii.2001, B. Merz & Landry leg. (MHNG). **ZH:** Zürich Katzenssee, 450 m a.s.l., 1 ♂, 1.viii.1995; Zürich Ziegelhütte, 460 m a.s.l., 1 ♂, 29.vi.1997, B. Merz leg. (MHNG).

*Notes:* This Holarctic species is common in Europe including the Mediterranean area (Spain, Italy and Slovenia), but also in North America. The larva forms a leaf mine on Gramineae. Mines were recorded on *Dactylis*, *Festuca*, *Holcus*, *Milium* and *Poa*.

**\**Cerodontha (Poemyza) pygmaea* (Meigen, 1830)**

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, 23.-31.viii.2000, pasture, MT, B. Merz leg. (CMB). **TI:** Biasca, Loderio, 350 m a.s.l., 1 ♂, 26.iii.1998, B. Merz leg. (MHNG).

*Notes:* This species from the *incisa*-group shows a Holarctic type of distribution and it is well known from a greater part of Europe. The larva forms a leaf mine on Gramineae. New for Switzerland.

**\**Cerodontha (Poemyza) spencerae* Zlobin, 1993**

*Material examined:* **BE:** Berner Alpen, Grindelwald env., 2500 m a.s.l., 4 ♂♂, 16.vi.1997, B. Mocek leg. (CBM).

*Notes:* This Holarctic species is based on the type series originating from Russia, Estonia and Kazakhstan. In the Palaearctic Region *C. (P.) spencerae* was recorded from the British Isles, the Czech Republic, Finland, Italy, Latvia, Lithuania, Slovakia, East Siberia and the Russian Far East incl. Sakhalin. In Europe it was once bred from *Agropyron repens*. New for Switzerland.

**\**Cerodontha (Xenophytomyza) atronitens* (Hendel, 1920)**

*Material examined:* **VS:** Leuk Pfynwald, 600-650 m a.s.l., 1 ♂, 19.v.1996, B. Merz & G. Bächli leg. (MHNG).



*Notes:* This species is distributed in temperate and northern Europe, but not yet found in the Mediterranean area. Host plants are unknown but certainly it is an internal feeder in the leaf-sheath or stem of Gramineae. New for Switzerland.

***Cerodontha (Xenophytomyza) biseta* (Hendel, 1920)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **GE:** Cartigny, Moulin de Vert, 350 m a.s.l., 1 ♂, 9.vii.2001, B. Merz leg. (MHNG). **VS:** Leuk Pfynwald, 600 m a.s.l., 1 ♂, 6.vi.2001, 1 ♂, 7.vi.2001, B. Merz & Landry leg. (MHNG). **ZH:** Zürich Hönggerberg, 530 m a.s.l., 1 ♂, 9.vi.1998; Zürich Waldgarten, 460 m a.s.l., 1 ♂, 7.vi.1997; Zürich Ziegelhütte, 460 m a.s.l., 2 ♂♂, 29.vi.1997, B. Merz leg. (MHNG).

*Notes:* *C. (X.) biseta* shows a Holarctic distribution and it is known to occur particularly in Europe including the Mediterranean area but also in Japan and North America (Canada and United States). The single specimen of *C. (X.) biseta* collected from the Jamaican Blue Mountains represents the first Neotropical record (Boucher, 2003). Host plants unknown, certainly an internal feeder in Gramineae.

**\**Chromatomyia fuscula* (Zetterstedt, 1838)**

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., pasture, 1 ♂, 23.-31.viii.2000, MT, B. Merz leg. (CMB). **SZ:** Unteriberg, O. Weid, 1600 m a.s.l., 1 ♂, 24.vii.2001. **TI:** Biasca, Loderio, 350 m a.s.l., 1 ♂, 15.iii.1994, 1 ♂, 23.iii.1996, 1 ♂, 26.iii.1998. **VS:** Branson, Follatères, 450-950 m a.s.l., 2 ♂♂, 29.iii.2002, B. Merz leg. (MHNG); Leuk Pfynwald, 600 m a.s.l., 1 ♂, 6.vi.2001, B. Merz & Landry leg. (MHNG); Visperterminen Dorf, 1550 m a.s.l., 1 ♂, 27.viii.2001, B. Merz & Landry leg. (MHNG).

*Notes:* *Ch. fuscula* has a Holarctic distribution. In Europe this species is known to occur chiefly in temperate and northern parts. Also recorded in the East Palaearctic: Russia (Asian part), Kamchatka and Japan. The larva forms leaf-mines on Gramineae. New for Switzerland.

***Chromatomyia gentianella* (Hendel, 1932)**

*References:* Hendel, 1931-6: 311; Spencer, 1990: 396; Martinez, 1998: 270.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 2 ♂♂, 21-31.viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* This mountain species is only known from Central Europe (Austria, North Italy, Poland and Switzerland). Larva forms a linear mine on *Gentiana*.

***Chromatomyia hoppiella* Spencer, 1990**

*References:* Spencer, 1990: 396; Martinez, 1998: 270.

*Material examined:* **GR:** Ausserferrera, 1300 m a.s.l., 1 ♂, 15.viii.1991, B. Merz & A. Freidberg leg. (MHNG); Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB); Valbella Casoja, 1500 m a.s.l., 1 ♂, 19.vii.2000, B. Merz leg. (MHNG).

*Notes:* *Ch. hoppiella* was described recently from Switzerland (Lenzerheide), based on the male holotype which was bred from *Gentiana excisa*. Our records represents the first additional faunistic data after the description.

***Chromatomyia horticola* (Goureau, 1851)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **VS:** Branson Follatères, 450-950 m a.s.l., 1 ♂, 29.iii.2002, B. Merz leg. (MHNG). **ZH:** Zürich Oerlikon, 430 m a.s.l., 1 ♀, 23.v.1992, leaf mine ex *Centaurea* sp., B. Merz leg. (MHNG).

*Notes:* A polyphagous species, common in the Palaearctic, Afrotropical and Oriental Regions. *Ch. horticola* is a well known and common species mining a large spectrum of host plants, Griffiths (1967) and Spencer (1973) recorded host plants belonging to 34 families. The larva forms a long whitish upper surface corridor, which may go to the lower surface.

**\**Chromatomyia isicae* (Hering, 1962)**

*Material examined:* **TI:** Biasca, Loderio, 300 m a.s.l., 1 ♂, 9.iv.1995, B. Merz leg. (MHNG).

*Notes:* This species was described from Austria. It is also recorded from the Czech Republic, Finland, Germany, Ireland, Lithuania, Norway and Sweden. Its biology is unknown. New for Switzerland.

***Chromatomyia milii* (Kaltenbach, 1864)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB); Valbella Casoja, 1550 m a.s.l., 1 ♂, 13.vii.1996, 1 ♂, 15.vii.1996, B. Merz leg. (MHNG). **TI:** A. d'Arena, 1700 m a.s.l., 1 ♂, 20.vii.1983, C. Besuchet leg. (MHNG); Biasca Loderio, 350 m a.s.l., 1 ♂, 23.iii.1996, 300 m a.s.l., 1 ♂, 9.iv.1995, B. Merz leg. (MHNG); Gordola, Bolle d. M., 205 m a.s.l., 1 ♂, 6.vii.2001, B. Merz leg. (MHNG). **ZH:** Embrach Haumüli, 430 m a.s.l., 1 ♂, 3.vii.1996, B. Merz leg. (MHNG); Zürich Albisgütli, 450 m a.s.l., 1 ♂, 27.iii.1994, 500 m a.s.l., 1 ♂, 2.iv.1997, B. Merz leg. (MHNG); Zürich Allmend, 450 m a.s.l., 2 ♂♂, 30.iii.1994, B. Merz leg. (MHNG); Zürich Katzenssee, 440 m a.s.l., 1 ♂, 19.iv.1997, B. Merz leg. (MHNG); Zürich, 1 ♂, 26.vii.1987, B. Merz leg. (MHNG).

*Notes:* A Holarctic species which is common in the West Palaearctic and in North America (Canada) but it is also recorded from India. This species feeds in the larval stage on a variety of soft-leaved wild grasses in mesic and woodland habitats. It is not a pest of cultivated cereals, and large marsh grasses, such as *Phragmites*; *Phalaris* and *Glyceria* are also apparently avoided.

***Chromatomyia nigra* (Meigen, 1830)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **GR:** Lenzerheide Sundroina, 1550 m a.s.l., 1 ♂, 18.vii.1997, B. Merz leg. (MHNG). **SG:** Chäserrugg, 1850 m a.s.l., 1 ♂, 15.viii.1997, B. Merz leg. (MHNG).

*Notes:* A Holarctic species. Its distribution area in the Palaearctic and Nearctic Regions seems to be larger than in the related *Ch. milii*. It was also recorded in the Oriental Region. The larva forms a narrow, whitish linear mine on many genera of Gramineae.



**\**Chromatomyia opacella*** (Hendel, 1935)

*Material examined:* **GR:** Lenzerheide, Sanaspans, 2150 m a.s.l., 1 ♂, 14.vii.1996, B. Merz leg. (MHNG).

*Notes:* This mountain species is distributed up to the subalpine and alpine zones of the Polish Tatra Mts. It penetrates far to the North (Iceland and Faroes Islands). Recently recorded from Central Europe (Černý & Vála, 2005), known also from the British Isles and North Italy. One record from Greenland is mentioned by Griffiths (1980). Immature stages and the mine are unknown. *Sesleria tatrae* and *Trisetum fuscum* are recorded as host plants. Our record extends its range of alpine localities from Austria and Italy to Switzerland. New for Switzerland.

**\**Chromatomyia pseudomilii*** Griffiths, 1980

*Material examined:* **VS:** Visperterminen Dorf, 1550 m a.s.l., 1 ♂, 27.viii.2001, B. Merz & Landry leg. (MHNG).

*Notes:* This mountain species was described from Germany; it is also known from mountains of the Czech Republic (Černý & Vála, 1996), from the High Tatra Mts in Slovakia (Černý & Vála, 2005) as well as from North America (United States and Alaska). Its occurrence in further European mountains is very likely. The larva forms leaf mines on Gramineae and *Carex*. New for Switzerland.

***Chromatomyia ramosa*** (Hendel, 1923)

*References:* Spencer, 1992: 142; Martinez, 1998: 270.

*Material examined:* **JU:** Alle, 450 m a.s.l., 1 ♂, 6.ix.1989, B. Merz leg. (MHNG). **ZH:** Volketswil, Homberg, 500 m a.s.l., 1 ♂, 7.vi.1995, B. Merz leg. (MHNG).

*Notes:* A common species in Europe which was also recorded from China. The larva feeds primarily along midrib, forming short offshoots into the leaf-blade in *Dipsacus*, *Knautia* and *Succisa*.

**\**Galiomyza galiivora*** (Spencer, 1969)

*Material examined:* **GE:** Jussy, Prés-de-Villette, 475 m a.s.l., 1 ♂, 2.viii.2002, B. Merz leg. (MHNG).

*Notes:* *G. galiivora* was described by Spencer (1969) from specimens bred from *Galium* in the United States. It is also recorded in Canada and Europe (Belgium, Corsica, the Czech Republic, Germany, Lithuania, Poland and Slovakia). New for Switzerland.

***Galiomyza morio*** (Brischke, 1880)

*Reference:* Martinez, 1998: 270.

*Material examined:* **NE:** St. Blaise Les Riedes, 470 m a.s.l., 1 ♂, 19.v.2001, B. Merz leg. (MHNG).

*Notes:* Also this species is mining *Galium*, but it was also bred from *Asperula odorata* (= *Galium odoratum*). Its distribution area includes Europe and Japan. The larva forms a narrow linear mine which may largely fill small leaves and produce a secondary blotch.

**\**Liriomyza approximata* (Hendel, 1920)**

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, 21-31.viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* This species of mixed forests is known from Central and Northern Europe where it was found in Austria, Finland, Germany, Hungary, Northern Italy and Poland. The larva forms an upper surface blotch mine on *Daphne mezereum*. New for Switzerland.

***Liriomyza congesta* (Becker, 1903)**

*Reference:* Martinez, 1998: 270.

*Material examined:* **SH:** Merischausen, Ladel, 700 m a.s.l., 1 ♂, 13.v.1991, B. Merz leg. (MHNG). **ZH:** Zürich Katzenssee, 440 m a.s.l., 1 ♂, 25.v.1996, B. Merz leg. (MHNG).

*Notes:* Generally distributed in the West Palaearctic but apparently ranging to Japan. Common in the Mediterranean area (Albania, Corsica, Egypt, Italy incl. Sardinia, Maltese Islands, Spain and Turkey). The larva forms an upper surface linear mine exclusively on Leguminosae, with many genera being attacked, in particular *Medicago*, *Lathyrus*, *Pisum* and *Vicia*.

**\**Liriomyza erucifolii* de Meijere, 1944**

*Material examined:* **TI:** Biasca, Loderio, 300 m a.s.l., 1 ♂, 9.iv.1995, B. Merz leg. (MHNG).

*Notes:* This species is based on the male holotype from France and later recorded from the Czech Republic, Denmark, England, the Netherlands and Poland. Recently found on the Maltese Islands (Černý, 2005b). The larva forms a relatively long linear mine, normally beginning near the apex of the leaf on *Senecio erucifolius* and *S. jacobaea*. New for Switzerland.

***Liriomyza flaveola* (Fallén, 1823)**

*Reference:* Martinez, 1998: 271.

*Material examined:* **GE:** Chancy, La Laire, 350 m a.s.l., 2 ♂♂, 24.iv.2003, B. Merz & F. Amiet leg. (MHNG). **ZH:** Zürich, 600 m a.s.l., 1 ♂, 10.vi.1991, B. Merz leg. (MHNG).

*Notes:* A common European species but known to occur also in Turkey, eastern Russia (East Siberia, Far East, Kamchatka, Kuril Islands), Uzbekistan, Japan and India. The larva forms a narrow, whitish leaf mine on Gramineae, occurring on many genera, particularly *Bromus*, *Dactylis*, *Holcus* and *Poa*, also on cultivated *Avena sativa* and *Hordeum vulgare*.

**\**Liriomyza lutea* (Meigen, 1830)**

*Material examined:* **VS:** Visperterminen, 1460 m a.s.l., 1 ♂, 23.vii.1992, B. Merz leg. (MHNG).

*Notes:* Widespread in Europe but local, frequently occurring in large numbers in association with the food-plants. The larva feeds in individual seeds on *Angelica sylvestris*, *Heracleum sphondylium* and *Pastinaca sativa*, probably also on *Laserpitium*. New for Switzerland.



**\**Liriomyza obliqua* Hendel, 1931**

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, 21-31.viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* *L. obliqua* is distributed in temperate Europe and in the Mediterranean area (Austria, Bulgaria, Germany, Lithuania, Romania, Slovakia, former Yugoslavia and Ukraine). Its biology is unknown. New for Switzerland.

***Liriomyza polygalae* Hering, 1927**

*Reference:* Martinez, 1998: 271.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 2 ♂♂, viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* The species was described by Hering (1927) from Lugano (TI) in Switzerland. It is known to occur mainly in Central Europe but also in England. This is the second record from Switzerland. The larva forms an irregular linear-blotch mine on *Polygala vulgaris*.

**\**Liriomyza taraxaci* Hering, 1927**

*Material examined:* **VS:** Leuk Pfynwald, 630 m a.s.l., 2 ♂♂, 23.iv.1998, B. Merz & Botta leg. (MHNG).

*Notes:* A Holarctic species which is common in Europe, but known only from Slovenia and Spain in the Mediterranean area. In North America recorded from Canada and United States. The larva forms a somewhat irregular, elongate blotch leaf mine on *Taraxacum*. New for Switzerland.

**\**Metopomyza flavonotata* (Haliday, 1833)**

*Material examined:* **VS:** Leuk Platten, 625 m a.s.l., 1 ♂, 30.v.2002; Visperterminen Kreuz, 1400 m a.s.l., 1 ♂, 3.vi.2003, B. Merz leg. (MHNG).

*Notes:* This is a type species of the genus *Metopomyza*. It is common in Europe as well as in Russia (incl. Siberia and Far East) and Japan. Its biology is unknown, Pakalniškis (1998a) recorded *Deschampsia caespitosa* as a host plant for the first time. New for Switzerland.

**\**Metopomyza nigriorbita* (Hendel, 1931)**

*Material examined:* **GE:** Bernex, Chante-Merle, 415 m a.s.l., 1 ♂, 16.viii.2002, B. Merz leg. (MHNG).

*Notes:* A Palaearctic species which is common in Europe but not known in southern parts. Recorded also from Japan. The puparium is dark brown, with posterior spiracles each having a bunch of about 6 irregular bulbs (Spencer, 1976) but the host plant is unknown. New for Switzerland.

**\**Metopomyza scutellata* (Fallén, 1823)**

*Material examined:* **GE:** Jussy, Prés-de-Villette, 475 m a.s.l., 1 ♂, 2.viii.2002, B. Merz leg. (MHNG); Russin, Les Baillets, 405 m a.s.l., 1 ♂, 1.vii.2002, B. Merz & Herrmann leg. (MHNG). **VS:** Leuk Pfynwald, 630 m a.s.l., 1 ♂, 6.vi.1997, B. Merz leg. (MHNG), 625 m a.s.l., 1 ♂, 16.v.2000, B. Merz & Ulrich leg. (MHNG). **ZH:**

Zürich, 500 m a.s.l., 2 ♂♂, 10.viii.1991, B. Merz leg. (MHNG); Zürich Waldgarten, 460 m a.s.l., 1 ♂, 30.vii.1997, B. Merz leg. (MHNG).

*Notes:* A Palearctic species which is, in addition to Europe, also recorded from Kazakhstan, Kyrgyzstan, eastern Russia (East Siberia, Far East) and Japan. Species of *Carex* are host plants. New for Switzerland.

**\**Metopomyza xanthaspis* (Loew, 1858)**

*Material examined:* **NE:** St. Blaise, Les Riedes, 470 m a.s.l., 2 ♂♂, 19.v.2001, B. Merz leg. (MHNG). **VS:** Grächen, 1450 m a.s.l., 1 ♂, 5.vi.1987, B. Merz leg. (MHNG); Leuk Pfywald, 630 m a.s.l., 1 ♂, 6.vi.2001, B. Merz & B. Landry leg. (MHNG).

*Notes:* A common species in Europe, ranging to the Mediterranean area (Croatia, Spain, Tunisia), Kazakhstan, Asian Russia and Japan. The larvae feed as leaf miner on *Carex humilis*. New for Switzerland.

**\**Napomyza bellidis* Griffiths, 1967**

*Material examined:* **GE:** Chancy, La Laiterie, 350 m a.s.l., 1 ♂, 18.iv.2003, B. Merz leg. (MHNG).

*Notes:* This species is based on a type series reared from *Bellis perennis* in England and later recorded from further European countries (Austria, Belgium, England, Estonia, France, Germany, Hungary, Italy, Latvia, Lithuania, Maltese Islands, Portugal, Russia, Sweden and Ukraine) and Central and East Palearctic (Uzbekistan, Japan). New for Switzerland.

***Napomyza cichorii* Spencer, 1966**

*Reference:* Martinez, 1998: 271.

*Material examined:* **VS:** Saas-Fee, 2400 m a.s.l., 1 ♂, 22.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes:* This species was described from a pair reared from *Cichorium intybus* originating from the Netherlands and one male from an alpine meadow in Switzerland (VS: Orsières). Our male confirms the occurrence in the canton Valais. It is distributed mainly in temperate Europe, the Mediterranean region and penetrates to Armenia, East Siberia, Far East and Japan. The larvae feed in stems and roots of *Cichorium intybus* and *C. endivia* (Asteraceae).

**\**Napomyza elegans* (Meigen, 1830)**

*Material examined:* **GR:** Valbella, 1500 m a.s.l., 1 ♀, 28.vii.1999, leg. B. Merz & Müller (MHNG).

*Notes:* A European species which is more common in temperate and northern Europe. Host plants and early stages are unknown but flies are not infrequently caught on flowers of *Valeriana officinalis* and it is believed the larva may feed in the root of this plant. New for Switzerland.

**\**Napomyza maritima* von Tschirnhaus, 1981**

*Material examined:* **TI:** Biasca, 350 m a.s.l., 1 ♂, 18.v.1991, B. Merz leg. (MHNG).

*Notes:* This species was described from Germany and France and it is also recorded from the Czech Republic, Finland, Hungary, Kazakhstan, Russia, Slovenia and Uzbekistan. The larva feeds in stems of *Artemisia maritima*. This plant does not occur in Switzerland. Other species of *Artemisia*, like *A. campestris* and *A. vulgaris*, both common in Biasca, may be infested by this species. New for Switzerland.

**\**Napomyza nigriceps* van der Wulp, 1871**

*Material examined:* **GE:** Chancy, La Laire, 350 m a.s.l., 1 ♂, 1.iv.2002, 1 ♂, 18.iv.2003, B. Merz leg. (MHNG).

*Notes:* The species is known from Western, Central and Northern Europe, but it is not recorded in the Mediterranean area. Its biology is unknown. New for Switzerland.

**\**Napomyza tripolii* Spencer, 1966**

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, 21-31.viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* The type series of this species was caught on *Aster tripolium* in England. Later records includes localities in Denmark, Germany, Ireland and Spain. The larva feeds in the stem of *Aster tripolium*. This plant does not occur in Switzerland. On the other hand, *A. alpinus* is a common plant in the collecting and may be host of *N. tripolii*. New for Switzerland.

***Phytoliriomyza arctica* (Lundbeck, 1901)**

*Reference:* Martinez, 1998: 271.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB); Rothenbrunnen, 600 m a.s.l., 1 ♂, 25.xi.1992. **VS:** Baltschieder, 670 m a.s.l., 1 ♀, 12.v.1991; Branson, Follatères, 450-950 m a.s.l., 1 ♂, 29.iii.2002; Leuk Pfynwald, 650 m a.s.l., 1 ♂, 2.v.1997, B. Merz leg. (MHNG).

*Notes:* Almost cosmopolitan species but not known from the Afrotropical Region; common in Europe. Early stages unknown, but once reported as stem miner on *Sonchus*, probably also on other Asteraceae.

***Phytoliriomyza melampyga* (Loew, 1869)**

*Reference:* Martinez, 1998: 271.

*Material examined:* **VS:** Leuk Pfynwald, 600 m a.s.l., 1 ♂, 25.viii.2001, B. Merz & Landry leg. (MHNG).

*Notes:* This Holarctic species is common in temperate and northern Europe and also recorded from North America and Oriental Region (India). The larva forms a leaf mine on *Impatiens* particularly on *I. noli-tangere* and *I. parviflora*.

**\**Phytoliriomyza perpusilla* (Meigen, 1830)**

*Material examined:* **VS:** Branson, Follatères, 450-950 m a.s.l., 1 ♂, 29.iii.2002, B. Merz leg. (MHNG).

*Notes:* *P. perpusilla* is distributed everywhere in Europe including the Mediterranean area and penetrates to the Afrotropical Region (Cape Verde Is., Lesotho,



South Africa). Host plant unknown but probably several genera of Asteraceae (Spencer, 1976). New for Switzerland.

***Phytomyza affinis* Fallén, 1823**

*References:* Hendel, 1931-6: 334; Martinez, 1998: 271.

*Material examined:* **GR:** Valbella Casoja, 1500 m a.s.l., 1 ♂, 19.vii.2000, B. Merz leg. (MHNG).

*Notes:* A species known to occur in the West Palaearctic, in particular in temperate and northern Europe but also recorded in the Mediterranean area and the Far East (Kuril Islands). The larva feeds in seed-heads on *Euphrasia*.

**\**Phytomyza albipennis* Fallén, 1823**

*Material examined:* **GR:** S. Vittore, Monticello, 280 m a.s.l., 2 ♂♂, 8.iv.1997, B. Merz leg. (MHNG).

*Notes:* This species is recorded from Europe including the Mediterranean area (Croatia, Canary Islands, Italy, Spain and the former Yugoslavia). Host plant unknown but some specimens have been caught on *Ranunculus* and the larvae possibly feed as an internal stem-borer (Spencer, 1972b, 1990). New for Switzerland.

***Phytomyza angelicae* Kaltenbach, 1872**

*Reference:* Martinez, 1998: 271.

*Material examined:* **JU:** Bonfol, 450 m a.s.l., 1 ♂, 30.iv.1990, B. Merz leg. (MHNG).

*Notes:* A Holarctic species which is known from temperate and northern Europe (not recorded from southern Europe), Kazakhstan, Turkey and North America. The larva forms an upper surface blotch leaf mine on *Angelica silvestris*, *A. archangelica*, *Laserpitium latifolium*, infrequently also on *Aegopodium podagraria*.

***Phytomyza artemisivora* Spencer, 1971**

*Reference:* Martinez, 1998: 271.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* This species was described from England, Denmark and Germany. *P. artemisivora* is distributed in the Palaearctic Region from temperate and northern Europe to Kyrgyzstan and Japan. Not confirmed in the Mediterranean area. The larva forms a white linear leaf mine on *Artemisia vulgaris*.

***Phytomyza brischkei* Hendel, 1922**

*References:* Hendel, 1931-6: 364; Martinez, 1998: 271.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 25 ♂♂, viii.2000, 2 ♂♂, 21.-31.viii.2000, pasture, MT, B. Merz leg. (CMB); Lenzerheide, Sundroina, 1520 m a.s.l., 1 ♂, 17.v.1997, B. Merz leg. (MHNG). **VS:** Saas-Fee, 1800-2100 m a.s.l., 2 ♂♂, 26.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes:* The species is only known from temperate Europe, no records are available from northern and southern Europe. Host plants are species of *Trifolium*, particularly *T. repens*, *T. pratense*, *T. fragiferum* and *T. alpinum*.

**\*Phytomyza calthivora** Hendel, 1934

*Material examined:* **GE:** Versoix, Bois du Faisan, 400 m a.s.l., 1 ♂, 6.iv.2002, B. Merz leg. (MHNG).

*Notes:* A rare species of temperate and northern Europe which can be found at localities where *Caltha palustris*, the host plant, occurs. The larva forms a short and broad leaf mine. New for Switzerland.

**\*Phytomyza calthophila** Hering, 1931

*Material examined:* **GE:** Versoix, Bois du Faisan, 400 m a.s.l., 1 ♂, 6.iv.2002, B. Merz leg. (MHNG).

*Notes:* *P. calthophila* is more common in temperate and northern Europe than the preceding species, though both species may occur together at same sites on *Caltha palustris*. Compared with *P. calthivora* the leaf mine formed by the larva is long and narrow. New for Switzerland.

**Phytomyza chaerophylli** Kaltenbach, 1856

*Reference:* Martinez, 1998: 271.

*Material examined:* **VS:** Leuk Pfynwald, 600 m a.s.l., 1 ♂, 25.viii.2001, B. Merz & Landry leg. (MHNG).

*Notes:* This species is known from Europe including the Mediterranean area and also recorded from Turkey and Japan. The larva forms a linear leaf mine on *Chaerophyllum*, *Anthriscus sylvestris*, less frequently on *Conium maculatum*, *Conopodium majus*, probably also on *Carum*, *Daucus*, *Sison* and *Torilis*.

**Phytomyza continua** Hendel, 1920

*Reference:* Martinez, 1998: 271.

*Material examined:* **ZH:** Zürich, 420 m a.s.l., 1 ♀, 30.vi.1989, B. Merz leg. (MHNG).

*Notes:* Very common in Europe and also recorded from China, Kamchatka and Japan. The larva feeds along the midrib of leaves of *Cirsium* and *Carduus*.

**\*Phytomyza crassiseta** Zetterstedt, 1860

*Material examined:* **GE:** Bernex, Signal, 510 m a.s.l., 1 ♂, 8.vii.2001, B. Merz leg. (MHNG).

*Notes:* *P. crassiseta* has a typically dilated arista. This Holarctic species is common in Europe and also recorded from Russia (including the Asian part), Kuril Islands, Japan and the United States. The larva forms a linear mine, initially adjoining leaf margin on *Veronica*. New for Switzerland.

**\*Phytomyza eumorpha** Frey, 1946

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, 21.-31.vii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* This species was described from Finland and Spencer (1976) recorded it later from Sweden. Our locality is the first one in Central Europe. The biology of *P. eumorpha* is unknown. New for Switzerland.

**\**Phytomyza evanescens* Hendel, 1920**

**Material examined:** **ZH:** Zürich Oerlikon, 430 m a.s.l., 1 ♂, 23.v.1992, B. Merz leg. (MHNG).

**Notes:** Zlobin (1994) reclassified this species and placed it in *Phytomyza* where it belongs to the *albipennis*-group. *P. evanescens* is characterized by a flap-like appendage on the epandrium. This Holarctic species is distributed in Europe from Island to the Mediterranean area (Dalmatia, Sicily and Spain), and also recorded from Tajikistan, Kuril Islands and North America. The larva feeds internally in the stem of *Ranunculus acris* and *R. lanuginosus*. New for Switzerland.

***Phytomyza fallaciosa* Brischke, 1880**

**Reference:** Martinez, 1998: 271.

**Material examined:** **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB).

**Notes:** *P. fallaciosa* was described from Poland. Its distribution area includes Europe and the easternmost Palearctic (Kuril Islands). The larva forms a leaf mine on *Ranunculus*, particularly on *R. repens*, but also on *R. lingua*.

**\**Phytomyza flavicornis* Fallén, 1823**

**Material examined:** **GE:** Chancy, La Laiterie, 350 m a.s.l., 1 ♂, 18.iv.2003. **JU:** Lucelle, 560 m a.s.l., 1 ♀, 30.iv.1990. All B. Merz leg. (MHNG).

**Notes:** This Holarctic species is common in Europe and North America. The larva feeds as an internal stem borer on *Urtica dioica*. New for Switzerland.

***Phytomyza glechomae* Kaltenbach, 1862**

**Reference:** Martinez, 1998: 271.

**Material examined:** **GE:** Chancy, La Laiterie, 350 m a.s.l., 2 ♂♂, 18.iv.2003; Chancy Vers Vaux, 335 m a.s.l., 1 ♂, 1.vi.2002, B. Merz leg. (MHNG).

**Notes:** *P. glechomae* is common in Europe, Japan and North America. The larva forms a distinctive leaf mine on *Glechoma hederacea*.

**\**Phytomyza gymnostoma* Loew, 1858**

**Material examined:** **SZ:** Brunnli, 900 m a.s.l., 1 ♀, 26.vi.1990, B. Petersen leg. (ZMUC). **VS:** Leuk Pfynwald, 630 m a.s.l., 1 ♂, 21.iv.1998, B. Merz & Botta leg. (MHNG); Saas-Fee, 2000-2200 m a.s.l., 1 ♀, 21.vii.1965, O. Lomholdt leg. (ZMUC).

**Notes:** The species was described from Poland and later recorded from further European countries, Turkey and Turkmenistan. Recently, this large species is considered to be a pest on *Allium* sp. with a certain economic importance (Spencer, 1973). New for Switzerland.

**\**Phytomyza heracleana* Hering, 1937**

**Material examined:** **BE:** Berner Alpen, Grindelwald env., 2500 m a.s.l., 1 ♂, 1 ♀, 16.vi.1997, B. Mocek leg. (CBM).

**Notes:** *P. heracleana* was described from Germany and it is distributed mainly in countries of temperate Europe. Rarely it is also recorded from the Mediterranean



area (Bulgaria and Italy). The larva forms a regular, interparenchymal blotch leaf mine on *Heracleum sphondylium*, *H. sibiricum*, and *H. mantegazzianum*. New for Switzerland.

**\**Phytomyza hirsuta* Spencer, 1976**

*Material examined*: **GR**: Lenzerheide, Piz Danis, 2250-2490 m a.s.l., 1 ♂, 12.vii.1996, B. Merz leg. (MHNG).

*Notes*: This species was described from Finland and Norway. Later it was also recorded from Sweden. Recently this species was found in the High Tatra Mts in Slovakia (Černý & Vála, 2005). Our record represents the southernmost locality in Europe. New for Switzerland.

**\**Phytomyza homogyneae* Hering, 1927**

*Material examined*: **GR**: Lenzerheide, 2000 m a.s.l., 1 ♂, 21-31.viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes*: This mountain species was described from Germany, where it was reared from *Homogyne alpina*, where the larva forms a linear mine. The species is known from Central European mountains (recently found in the Šumava Mts, Czech Republic, Černý & Vála, 2005) but also from China, Japan and Taiwan. New for Switzerland.

***Phytomyza nigripennis* Fallén, 1823**

*References*: Hendel, 1931-6: 439; Martinez, 1998: 272.

*Material examined*: **GE**: Chancy, La Laiterie, 350 m a.s.l., 1 ♂, 24.iv.2003, B. Merz & F. Amiet leg. (MHNG). **ZH**: Zürich Allmend, 450 m a.s.l., 1 ♀, 1.v.1995, B. Merz leg. (MHNG); Zürich Waldgarten, 1 ♂, 31.iii.1997, B. Merz leg. (MHNG).

*Notes*: This species is characterized by conspicuously dark wings. It is distributed in temperate and northern Europe, with a few localities in Northern Italy and former Yugoslavia. Its host plant is not known, but it may attack *Anemone nemorosa*. The larva feeds probably in the stem or the root, early stages unknown (Spencer, 1976).

***Phytomyza notata* Meigen, 1830**

*Reference*: Martinez, 1998: 272.

*Material examined*: **GR**: Lenzerheide, 2000 m a.s.l., 8 ♂♂, viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes*: This species is known from temperate and northern Europe including northern Italy. The larva forms a short, broad, linear mine recorded on *Ranunculus acer*, *R. auricomus*, *R. bulbosa* and particularly on *R. repens*.

**\**Phytomyza origani* Hering, 1931**

*Material examined*: **GE**: Cartigny, Moulin de Vert, 470 m a.s.l., 1 ♂, 4.vi.2001, M. Eggenberger & B. Merz leg. (MHNG).

*Notes*: *P. origani* was described from Germany and later recorded from Bulgaria, the Czech Republic, Denmark, England, France, Hungary, Lithuania, Poland

and Spain. The larva forms a typical leaf mine on *Origanum vulgare* (Spencer, 1976). New for Switzerland.

**\**Phytomyza pauliloewii* Hendel, 1920**

*Material examined:* VS: Branson, Follatères, 450-950 m a.s.l., 1 ♂, 29.iii.2002, B. Merz leg. (MHNG).

*Notes:* This species is only locally distributed in temperate Europe but also known from northern Europe (Finland and Sweden) and the Mediterranean area (Italy). The larva forms a small regular blotch leaf mine on *Pimpinella* spp. and *Peucedanum oreoselinum*. New for Switzerland.

***Phytomyza plantaginis* Robineau-Desvoidy, 1851**

*Reference:* Martinez, 1998: 272.

*Material examined:* VS: Leuk Pfynwald, 650 m a.s.l., 1 ♂, 23.ix.1992, B. Merz & Otto leg. (MHNG), 630 m a.s.l., 1 ♂, 6.viii.1997, B. Merz leg. (MHNG).

*Notes:* *P. plantaginis* is a common species of the West Palaerctic and North America (Canada, United States). Rarely also known from the East Palaearctic, Afrotropical, Oriental and Australasian Regions. The larva forms a narrow, white linear leaf mine on *Plantago lanceolata* and *P. major*.

**\**Phytomyza platystoma* (Hendel, 1920)**

*Material examined:* VS: Branson, Follatères, 450-950 m a.s.l., 3 ♂♂, 29.iii.2002, B. Merz leg. (MHNG).

*Notes:* This alpine species was described as *Napomyza platystoma* but Spencer & Martinez (1987) transferred it to *Phytomyza*. It was described from Austria (Piestingtal, Nördliche Voralpen). This is the second record from Central Europe. Its biology is unknown. New for Switzerland.

**\**Phytomyza pubicornis* Hendel, 1920**

*Material examined:* GE: Avusy, Moulin de la Grave, 360 m a.s.l., 1 ♂, 18.iv.2003, B. Merz leg. (MHNG). ZH: Zürich Allmend, 440 m a.s.l., 1 ♂, 17.iv.1996, B. Merz leg. (MHNG).

*Notes:* This species is distributed in temperate and northern Europe. No records are known from the Mediterranean area. The larva forms a short linear leaf mine on *Aegopodium podagraria*. New for Switzerland.

**\**Phytomyza pullula* Zetterstedt, 1848**

*Material examined:* ZH: Affoltern a. A., 600 m a.s.l., 1 ♂, 8.viii.1987, B. Merz leg. (MHNG).

*Notes:* *P. pullula* belongs to the species with a Holarctic distribution. It is common in Europe and North America. The larva forms a narrow linear leaf mine on *Achillea*, *Anthemis*, *Chrysanthemum vulgare*, *Matricaria*, and most commonly on *M. inodora*. New for Switzerland.

***Phytomyza ranunculi* (Schrank, 1803)**

*References:* Hendel, 1931-6: 467; Martinez, 1998: 272.

*Material examined:* **GR:** Ausserferrera, 1300-1550 m a.s.l., 1 ♂, 18.vi.1994, B. Merz leg. (MHNG); Lenzerheide, 2000 m a.s.l., 1 ♂, 14.-21.vii.2000, pasture, MT, B. Merz leg. (CMB); Lenzerheide See, 1500 m a.s.l., 1 ♂, 15.vii.2000, B. Merz leg. (MHNG); Lenzerheide Sundroina, 1520 m a.s.l., 1 ♂, 17.v.1997, B. Merz leg. (MHNG). **TI:** Monte San Giorgio, 600-1100 m a.s.l., 1 ♂, 5.vii.2001, B. Merz leg. (MHNG). **ZH:** Zürich Zürichberg, 600 m a.s.l., 1 ♂, 5.v.1993, B. Merz leg. (MHNG), 1 ♂, 8.v.1996, P. Walser leg. (MHNG). **VD:** Bonvillars en fauchant [= sweeping], 630 m a.s.l., 1 ♀, 25.iv.1988, D. Burckhardt leg. (MHNG).

*Notes:* *P. ranunculi* is a common species mining Ranunculaceae in the Holarctic Region.

**\*Phytomyza ranunculicola** Hering, 1949

*Material examined:* **GE:** Bernex, Chante-Merle, 415 m a.s.l., 1 ♂, 20.v.2002, B. Merz leg. (MHNG).

*Notes:* The species was described from Germany. It is distributed in temperate Europe but it is probably absent from Scandinavia and the Mediterranean area. The larva forms a secondary blotch leaf mine on *Ranunculus acer*. New for Switzerland.

**\*Phytomyza rapunculi** Hendel, 1927

*Material examined:* **BE:** Berner Alpen, Grindelwald env., 2500 m a.s.l., 1 ♂, 1 ♀, 16.vi.1997, B. Mocek leg. (CBM). **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB).

*Notes:* This European species was described from Austria and later recorded particularly in temperate and southern Europe. In Scandinavia it is known only from Sweden (Spencer, 1990). The larva forms a linear mine on *Campanula rapunculoides*, *C. persicifolia* and *Phyteuma*. New for Switzerland.

**\*Phytomyza rhabdophora** Griffiths, 1964

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, viii.2000, pasture, MT, B. Merz leg. (CMB). Lenzerheide, Sundroina, 1550 m a.s.l., 1 ♂, 18.vii.1997, B. Merz leg. (MHNG). **VS:** Saas-Fee, 1800 m a.s.l., 1 ♂, 21.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes:* The type locality is in Germany and the species is distributed in temperate Europe, but it is apparently missing in the Mediterranean area. Its biology is unknown, larvae feed probably on *Leontodon* (Tschirnhaus, 1969). New for Switzerland.

**\*Phytomyza rostrata** Hering, 1933

*Material examined:* **VS:** Leuk Pfynwald, 600 m a.s.l., 1 ♂, 2.vii.2001, B. Merz leg. (MHNG).

*Notes:* The species was described from Germany and it is distributed in temperate Europe, but apparently absent from the Mediterranean area. The larva forms a typical mine on *Euphrasia*, *Melampyrum*, *Odontites* and *Rhinanthus* (Spencer, 1976). New for Switzerland.

**Phytomyza rufipes** Meigen 1830

*Reference:* Martinez, 1998: 272.



*Material examined:* **GE:** Cartigny, Moulin de Vert, 360 m a.s.l., 1 ♂, 1.v.1999, B. Merz leg. (MHNG).

*Notes:* This pale species is common in the West Palaearctic and North America. The larva feeds inside the stem or midrib of larger leaves on Brassicaceae, mainly on *Brassica*.

**\**Phytomyza sedi* Kaltenbach, 1869**

*Material examined:* **NE:** St. Blaise, Les Riedes, 470 m a.s.l., 2 ♂♂, 19.v.2001, B. Merz leg. (MHNG).

*Notes:* This species was described from Boppard (Germany) and later recorded from Spain under the synonym *Ph. catalaunica* Spencer, 1960. Our record confirms the occurrence in Central Europe. *Sedum* is the host plant of this species. New for Switzerland.

**\**Phytomyza soenderupi* Hering, 1941**

*Material examined:* **GE:** Versoix, Bois du Faisan, 400 m a.s.l., 1 ♂, 6.iv.2002, B. Merz leg. (MHNG).

*Notes:* This species was described from Denmark and later recorded from Belgium, the British Isles, the Czech Republic, Estonia, Germany and Norway. The larva feeds within the petiole of *Caltha palustris*. New for Switzerland.

***Phytomyza tenella* Meigen, 1830**

*Reference:* Martinez, 1998: 272.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., pasture, 2 ♂♂, 23.viii.-9.ix.2000, MT, B. Merz leg. (CMB); Juf-Stallerberg, 2400 m a.s.l., 1 ♂, 18.viii.1991, B. Merz & A. Freidberg leg. (MHNG).

*Notes:* *Phytomyza tenella* is distributed in Europe, China, Turkey, the United States and the Afrotropical Region (Ethiopia). The larva feeds in seed-heads of *Pedicularis palustris* and almost certainly other *Pedicularis*.

**\**Phytomyza varipes* Macquart, 1835**

*Material examined:* **GR:** Lenzerheide, Sundroina, 1550 m a.s.l., 1 ♂, 18.vii.1997, B. Merz leg. (MHNG).

*Notes:* This rare species was described from Northern France. The larva feeds in seed-heads of *Rhinanthus*. New for Switzerland.

***Phytomyza vitalbae* Kaltenbach, 1872**

*Reference:* Martinez, 1998: 272.

*Material examined:* **GR:** Lenzerheide, 2000 m a.s.l., 1 ♂, 14.-21.vii.2000, pasture, MT, B. Merz leg. (CMB). **VS:** Leuk Pfynwald, 600 m a.s.l., 2 ♂♂, 25.viii.2001, B. Merz & Landry leg. (MHNG).

*Notes:* A species known from various European countries and also from Canada, South Africa, China, Nepal, Taiwan and Australia. The larva forms a long, narrow, upper surface leaf mine on *Clematis vitalba*, *C. alpina* and some other *Clematis*.

***Phytomyza wahlgreni* Rydén, 1944**

*References:* Griffiths, 1964: 411; Spencer, 1976: 527; Martinez, 1998: 272.

*Material examined:* **AG:** Thalheim, 550 m a.s.l., 1 ♂, 20.v.1992, B. Merz leg. (MHNG). **GR:** Lenzerheide, 1600 m a.s.l., 1 ♂, 8.x.1991, B. Merz & M. Eggenberger leg. (MHNG); Lenzerheide, 2000 m a.s.l., 3 ♂♂, 14.-21.vii.2000, 2 ♂♂, 23.-31.viii.2000, pasture, MT, B. Merz leg. (CMB). **NE:** St. Blaise, Les Riedes, 470 m a.s.l., 1 ♂, 19.v.2001, B. Merz leg. (MHNG). **VS:** Saas-Fee, 2000 m a.s.l., 3 ♂♂, 18.vii.1965, 2400 m a.s.l., 1 ♀, 19.vii.1965, 2200 m a.s.l., 2 ♀♀, 21.vii.1965, 1800 m a.s.l., 1 ♀, 24.vii.1965, O. Lomholdt leg. (ZMUC).

*Notes:* A Holarctic species distributed in temperate and northern Europe. In the Mediterranean area known to occur in Italy. It is also recorded from the United States, China and the Kuril Islands. From Switzerland recorded by Griffiths (1964) for the first time (**VS:** Bérisal, under the synonym *P. taraxacocecis* Hering, 1949). The larva feeds in the midrib of leaves on *Taraxacum* spp.

**\*Pseudonapomyza atra** (Meigen, 1830)

*Material examined:* **FR:** Mt. Vully, Bas Vully, 460-650 m a.s.l., 1 ♂, 6.vi.2003, B. Merz & Amiet leg. (MHNG). **GE:** Bernex, Chante-Merle, 415 m a.s.l., 1 ♂, 16.viii.2002, B. Merz leg. (MHNG); Cartigny, Moulin de Vert, 360 m a.s.l., 1 ♂, 2.vi.2002, B. Merz leg. (MHNG); Chancy, La Laiterie, 350 m a.s.l., 1 ♂, 9.vii.2002, B. Merz leg. (MHNG). **VS:** Visperterminen, Giw-Gebidemsee, 1900-2200 m a.s.l., 1 ♂, 28.viii.2001, B. Merz & Landry leg. (MHNG). **ZH:** Zürich-Hönggerberg, 600 m a.s.l., 1 ♂, 26.iv.1993, B. Merz leg. (MHNG).

*Notes:* *Ps. atra* is generally distributed in the Holarctic Region. It is common in northern and temperate Europe (Černý 1992, 1998, 2005a). Spencer (1973) considered it to be rare in the Mediterranean area. The larva forms a short, narrow mine on Gramineae, feeding on many genera, e.g. *Apera*, *Avena*, *Hordeum*, *Lolium*, *Phalaris*, *Poa*, *Secale* and *Triticum*. New for Switzerland.

**\*Pseudonapomyza errata** Zlobin, 1993

*Material examined:* **GE:** Russin, Les Baillets, 405 m a.s.l., 1 ♂, 30.vi.2001, B. Merz leg. (MHNG). **NE:** St. Blaise, Les Riedes, 470 m a.s.l., 2 ♂♂, 19.v.2001, B. Merz leg. (MHNG). **VS:** Leuk Pfynwald, 600 m a.s.l., 1 ♂, 2.vii.2001; Visperterminen, 1400 m a.s.l., 1 ♂, 27.vii.1991, B. Merz leg. (MHNG).

*Notes:* This species was described from Russia, Uzbekistan and Mongolia and it is also recorded from the Czech Republic and France. Its biology is unknown. New for Switzerland.

**\*Pseudonapomyza eurasiatica** Zlobin, 2003

*Material examined:* **VS:** Leuk Pfynwald, 600 m a.s.l., 1 ♂, 6.vi.2001, 1 ♂, 7.vi.2001, B. Merz & Landry leg. (MHNG).

*Notes:* Recently described from the male holotype originating from Tajikistan and paratypes from Greece, Kazakhstan, Turkmenistan and Ukraine by Zlobin (2003b). This is the first record from Central Europe and represents the westernmost boundary of its distribution area. Biology is unknown. New for Switzerland.

**Pseudonapomyza europaea** Spencer, 1973

*References:* Papp, 1984: 313; Spencer, 1973: 270; Martinez, 1998: 272.

**Material examined:** VS: Leuk Pfynwald, 600 m a.s.l., 1 ♂, 25.v.1997, B. Merz leg. (MHNG), 2 ♂♂, 6.vi.2001; 1 ♂, 2.vii.2001; 1 ♂, 25.viii.2001, B. Merz & Landry leg. (MHNG).

**Notes:** Widely distributed in Europe and also recorded from Turkey and Japan (Černý, 2005a). It is less common than *Ps. atra*. Spencer (1973) described this species from Italy (holotype), Austria, Macedonia, Serbia, Slovenia and Switzerland (VS: Stalden). Its biology is unknown.

**\**Pseudonapomyza strobliana* Spencer, 1973**

**Material examined:** GE: Russin, Les Baillels, 405 m a.s.l., 1 ♂, 8.viii.2002, B. Merz leg. (MHNG). VS: Leuk Pfynwald, 600 m a.s.l., 1 ♂, 6.vi.2001, 1 ♂, 25.viii.2001, B. Merz & Landry leg. (MHNG).

**Notes:** The species was described from Dalmatia and Austria. The center of its distribution area is probably in the Mediterranean area (Spain, Bulgaria, Turkey) but recently it was also recorded from the Czech Republic, France, Germany, Hungary, Sweden and Ukraine (Černý, 1998, 2005a). Its biology is unknown. New for Switzerland.

**\**Pseudonapomyza vota* Spencer, 1973**

**Material examined:** VS: Leuk Pfynwald, 600 m a.s.l., 1 ♂, 7.vi.2001; Leuk Platten, 625 m a.s.l., 1 ♂, 8.vi.2001, all B. Merz & Landry leg. (MHNG).

**Notes:** This species was described from a single male originating from Spain. The distribution area of this species ranges from Spain to Israel, i.e. throughout the Mediterranean area. Biology of the species is unknown. New for Switzerland.

## CONCLUSIONS

This review embraces new data on the fauna of mining flies or Agromyzidae occurring in Switzerland and adds 92 species to the 140 species listed by Martinez (1998) bringing the list of Swiss agromyzids to 232 species. The potential number of Swiss Agromyzidae species is probably much higher, given the different origins of the native fauna and the unusually diverse pattern of ecosystems. Such a conclusion seems to be confirmed by a comparison of species richness in neighbouring countries. Franz (1989) listed 270 species from Austria and Tschirnhaus (1999) 552 species from Germany. According to Spencer (1992) many species known from the Italian alpine valleys will probably also be found in the Swiss Alps. Süss (1999, 2001, 2002) recorded 224 species in Italy (173 from North Italy); of this number 112 species are common for both countries and 112 species are known exclusively from Italy. So far, no species of *Hexomyza* Enderlein, 1936, has been recorded from Switzerland, although 6 species are known in Europe and 5 of them live in Italy. Likewise *Ptochomyza* Hering, 1942, with three European species and *Nemorimyza posticata* (Meigen, 1830) known from adjoining countries, have not been found so far in Switzerland. Of 10 European species of *Phytobia* Lioy, 1864, only *P. mallochii* is known from Switzerland, while *Melanagromyza* Hendel, 1920, is represented by four species only (11 % of the European species) and *Liriomyza* Mik, 1894, by 18 species (13 %). There is thus good evidence that the list of Swiss agromyzids is far from final.



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## **The millipede family Paradoxosomatidae in Paraguay, with descriptions of five new species (Diplopoda, Polydesmida)**

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**The millipede family Paradoxosomatidae in Paraguay, with descriptions of five new species (Diplopoda, Polydesmida).** - A review is provided of the millipede family Paradoxosomatidae in Paraguay, with keys compiled to 14 genera and 63 species occurring in this country and/or adjacent areas. Five species are described as new: *Catharosoma bilineatum* sp. n., *C. mahnerti* sp. n., *Broelemannopus minutus* sp. n., *Mestosoma simplex* sp. n. and *M. crassipes* sp. n.

**Keywords:** Diplopoda - Polydesmida - Paradoxosomatidae - taxonomy - Paraguay.

### **INTRODUCTION**

The family Paradoxosomatidae is among the largest among the Diplopoda, with nearly 200 genera currently accepted as valid. The American fauna is highly peculiar due to the absence of indigenous paradoxosomatids north of Costa Rica. In South America two major centres of diversification are distinguishable, one in the area of southern Brazil, Paraguay and northern Argentina, the other in Peru, northern Bolivia and possibly Ecuador. The vast regions of northern Brazil, Guiana, Venezuela and Colombia appear to harbour very few species (Jeekel, 1968, 2002).

The Neotropical fauna itself is strongly dominated by relatively few (about a dozen) genera of the endemic tribe Catharosomatini. Of these genera, *Mestosoma* Silvestri, 1897 is certainly the largest and particularly widespread, with about 75 species occurring throughout South America and reaching both Costa Rica and the island of Dominica (introduced?) in the north. *Catharosoma* Silvestri, 1913 is the second largest genus, its 13 species being known from Brazil, Paraguay and Argentina (Hoffman, 1980, 1999). The remaining genera are mono- to oligotypic.

The present paper provides a review of, and keys to, the bulk of the paradoxosomatids occurring in the southern Neotropical diversification centre, based both on all available literature sources and on the important collection of Paradoxosomatidae from Paraguay housed in the Muséum d'histoire naturelle, Geneva (MHNG). Five new species from three genera of Catharosomatini have been revealed there, all described below and thus considerably enriching our knowledge of the fauna of Paraguay. A few paratypes from the material have been retained for the collection of the Zoological Museum, State University of Moscow (ZMUM), Russia.

## FAUNISTIC REVIEW

Since detailed reviews of the history of research on Neotropical Paradoxosomatidae are available and still fully relevant (Jeekel, 1963, 1968), only a short account appears necessary here concerning the species list of the particular region involved. Virtually all later contributions (e.g. Hoffman, 1977, 1999; Golovatch, 1992; Jeekel, 2002; Golovatch *et al.*, 2003) are irrelevant in the present context, as they only or chiefly treat more northern faunas.

The following Paradoxosomatidae from Paraguay and/or the adjacent parts of Bolivia, northern Argentina and southern Brazil have hitherto been recognized as valid:

***Broelemannopus* Verhoeff, 1938**

*Broelemannopus escaramucensis* (Schubart, 1944) - Brazil (São Paulo) (Schubart, 1944, 1952)

*B. glabratus* (Schubart, 1945) - Brazil (Rio de Janeiro) (Schubart, 1945b)

*B. ibitiensis* (Schubart, 1945) - Brazil (São Paulo) (Schubart, 1945a)

*B. pirassunungensis* (Schubart, 1944) - Brazil (São Paulo) (Schubart, 1944, 1945a, 1952)

***Catharosoma* Silvestri, 1897**

*Catharosoma curitibense* Schubart, 1953 - Brazil (Paraná) (Schubart, 1953)

*C. digitale* Schubart, 1953 - Brazil (Paraná) (Schubart, 1953)

*C. hoffmani* Kraus, 1956 - Paraguay (Kraus, 1956)

*C. intermedium* (Carl, 1902) - Brazil (Rio Grande do Sul) (Carl, 1902; Attems, 1914, 1937)

*C. mesorpinum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953)

*C. mesoxanthum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953)

*C. mixtum* Kraus, 1956 - Brazil (Santa Catarina) (Kraus, 1956)

*C. myrmekurum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953)

*C. palmatum* Schubart, 1953 - Brazil (Paraná) (Schubart, 1953)

*C. palustre* Schubart, 1943 - Brazil (Mato Grosso) (Schubart, 1943)

*C. paraguayense* (Silvestri, 1895) - Paraguay, Argentina and Brazil (Santa Catarina and Mato Grosso) (Silvestri, 1895b, 1902; Attems, 1898, 1914, 1937; Schubart, 1953; Kraus, 1956; Jeekel, 1965) («South America», according to Mauriès, 1998)

*C. peraccae* Silvestri, 1902 - Paraguay (Silvestri, 1902; Attems, 1914, 1937)

*C. taeniatum* (Brolemann, 1929) - Brazil (Santa Catarina) (Brolemann, 1929; Attems, 1937; Schubart, 1953)

***Chondromorpha* Silvestri, 1897**

*Chondromorpha xanthotricha* (Attems, 1898) - pantropical, introduced (e.g. Jeekel, 1963)



***Gonodrepanoides* Schubart, 1945**

*Gonodrepanoides travassosi* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

***Gonodrepanum* Attems, 1914**

*Gonodrepanum drepanephoron* (Attems, 1898) - Brazil (São Paulo) and Argentina (Attems, 1898, 1901, 1914, 1937; Brölemann, 1902b; Mauriès, 1998)

*G. falciferum* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

*G. flavolineatum* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

*G. furcatum* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

*G. grajahuense* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

*G. levisetum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953; Mauriès, 1998)

*G. levisetum* var. *coniferum* (Attems, 1898) - Brazil (Santa Catarina) (Attems, 1898, 1914, 1937; Schubart, 1953; Mauriès, 1998)

*G. torresae* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

***Habrodesmoides* Attems, 1943**

*Habrodesmoides costalimai* (Schubart, 1945) - Brazil (Rio de Janeiro) (Schubart, 1945b)

*H. perturbans* Attems, 1943 - Brazil (Rio de Janeiro) (Attems, 1943)

***Mestosoma* Silvestri, 1897**

*Mestosoma alticola* (Attems, 1931) - Bolivia (Cochabamba) and Peru (Attems, 1931, 1937; Kraus, 1956)

*M. balzanii* (Silvestri, 1895) - Bolivia (Yungas) (Silvestri, 1895a; Attems, 1914, 1937)

*M. bicolor* Silvestri, 1898 - Paraguay and Brazil (Mato Grosso) (Silvestri, 1898, 1902; Attems, 1899, 1914, 1937; Jeekel, 1965)

*M. boliviae* (Chamberlin, 1957) - Bolivia (near Potosí) (Chamberlin, 1957)

*M. borellii* (Silvestri, 1895) - Argentina (Tucuman) and Paraguay (Silvestri, 1895b; Attems, 1914, 1937; Mauriès, 1998)

*M. camerani* (Silvestri, 1895) - Argentina (Chaco) (Silvestri, 1895b; Attems, 1914, 1937; Jeekel, 1965; Mauriès, 1998)

*M. carioca* (Schubart, 1945) - Brazil (Rio de Janeiro) (Schubart, 1945b)

*M. derelictum* (Silvestri, 1895) - Bolivia (Misiones Mosetenes) (Silvestri, 1895a; Attems, 1914, 1937)

*M. differens* Kraus, 1956 - Bolivia (Cochabamba) (Kraus, 1956)

*M. femorale* (Schubart, 1943) - Brazil (Mato Grosso) (Schubart, 1943)

*M. kalliston* (Attems, 1898) - Brazil (Rio Grande do Sul) (Attems, 1898, 1914, 1937)

*M. luctuosum* Silvestri, 1897 - Bolivia (Caiza) (Silvestri, 1897; Attems, 1914, 1937)

*M. lugubre* Silvestri, 1897 - Argentina (Buenos Aires) and Uruguay (Silvestri, 1897, 1902; Attems, 1914, 1937; Mauriès, 1998)

*M. montanum* (Silvestri, 1895) - Bolivia (Yungas) (Silvestri, 1895a; Attems, 1914, 1937)

*M. perfidum* (Schubart, 1943) - Brazil (São Paulo) (Schubart, 1943)

*M. pseudomorphum* (Silvestri, 1895) - Paraguay (Silvestri, 1895b; Carl, 1902; Attems, 1914, 1937; Jeekel, 1965)

*M. pulvillatum* (Attems, 1898) - Paraguay (Attems, 1898, 1901, 1914, 1937)

*M. salvadorii* (Silvestri, 1895) - Argentina (Salta), Bolivia (Chaco) and Paraguay (Silvestri, 1895b, 1902; Attems, 1914, 1937; Hoffman, 1977; also Costa Rica, according to Mauriès, 1998)

*M. schindleri* Kraus, 1956 - Bolivia (Silhuencas) (Kraus, 1956)

*M. tricuspis* (Verhoeff, 1938) - Paraguay (Verhoeff, 1938)

*M. truncatum* (Schubart, 1943) - Brazil (Mato Grosso) (Schubart, 1943)

*M. vittatum* (Attems, 1898) - Paraguay (Attems, 1898, 1914, 1937)

### ***Mogyella* Schubart, 1944**

*Mogyella nana* Schubart, 1944 - Brazil (São Paulo) (Schubart, 1944, 1952)

### ***Mogyosoma* Schubart, 1944**

*Mogyosoma hamatum* Schubart, 1944 - Brazil (São Paulo) (Schubart, 1944)

### ***Ologonosoma* Silvestri, 1898**

*Ologonosoma iguassuense* (Schubart, 1953) - Brazil (Paraná) (Schubart, 1953; Mauriès, 1998)

*O. sanctum* (Silvestri, 1895) - Paraguay (Silvestri, 1895a; Attems, 1914, 1937; Mauriès, 1998)

### ***Orthomorpha* Bollman, 1893**

*Orthomorpha coarctata* (De Saussure, 1860) - pantropical, introduced (e.g. Jeekel, 1963)

### ***Oxidus* Cook, 1911**

*Oxidus gracilis* (C. L. Koch, 1847) - subcosmopolitan, introduced (e.g. Jeekel, 1963)

### ***Promestosoma* Silvestri, 1898**

*Promestosoma boggianii* Silvestri, 1898 - Paraguay (Silvestri, 1898; Attems, 1899, 1914, 1937; Jeekel, 1965; Mauriès, 1998) and Brazil (Mato Grosso and Mato Grosso do Sul) (original data)

### ***Pseudogonodrepanum* Schubart, 1945**

*Pseudogonodrepanum scitum* Schubart, 1945 - Brazil (Rio de Janeiro) (Schubart, 1945b)

A few more species, i.e. *Mestosoma laetum* Silvestri, 1897 (Bolivia, San Francisco – Silvestri, 1897), «*Strongylosoma*» *nitidum* Brölemann, 1902 (Brazil, Cubatão, São Paulo – Brölemann, 1902a), «*Strongylosoma*» *pustulatum* Brölemann, 1902 (Brazil, São Paulo – Brölemann, 1902b) and *Catharosoma bromelicola* Schubart, 1945 (Brazil, Rio de Janeiro – Schubart, 1945b), the male characters of which are not or are insufficiently known, still remain *incertae sedis*; none can be included in a key (Jeekel, 1963).

The same concerns *Iulidesmus* Silvestri, 1895, with its type-species *I. typicus* Silvestri, 1895 known only from a female holotype from Bolivia (Yungas) (Silvestri, 1895a). Jeekel (1963) correctly excluded *Iulidesmus* from Paradoxosomatidae on the basis of a later redescription of *I. typicus* from Chilean material provided by Silvestri (1905). But Hoffman (1980), rightly doubting the conspecificity of the Bolivian and Chilean samples, believes that the holotype of *I. typicus* represents a *Mestosoma*. If so, then *Mestosoma* becomes a junior synonym of *Iulidesmus*. Only topotypic material in connection with revisionary work can shed additional light on the identity of all of the enigmatic taxa mentioned above.

## DESCRIPTIONS OF NEW SPECIES

### *Catharosoma bilineatum* sp. n.

Figs 1-9

**Material:** Holotype ♂ (MHNG), Paraguay, Alto Paraná Prov., Forestry Centre (C.F.A.P.), Puerto Presidente Stroessner, plot 7, 18.03.1983, leg. P. Berner & C. Dlouhy. – Paratypes: 1 ♀ (MHNG), same locality, together with holotype; 1 ♂, 3 ♀♀ (MHNG), 1 ♂, 1 ♀ (ZMUM), same locality, around Pindo trunk, plot 3, 24.03.1983, leg. C. Dlouhy; 1 ♀ (MHNG), same locality, soil sample, plot 4 (Monte natural), Winkler extraction, 10.03.1983, leg. C. Dlouhy; 1 ♀ (MHNG), same plot 4 (Monte natural), 10.03.1983, leg. P. Berner & C. Dlouhy; 1 ♀ (MHNG), same locality, soil sample, plot 2 (Monte natural), 29.02.1983, leg. C. Dlouhy; 1 ♂ (MHNG), same locality, soil sample, plot 8 (Monte natural), 18.03.1983, leg. P. Berner & C. Dlouhy.

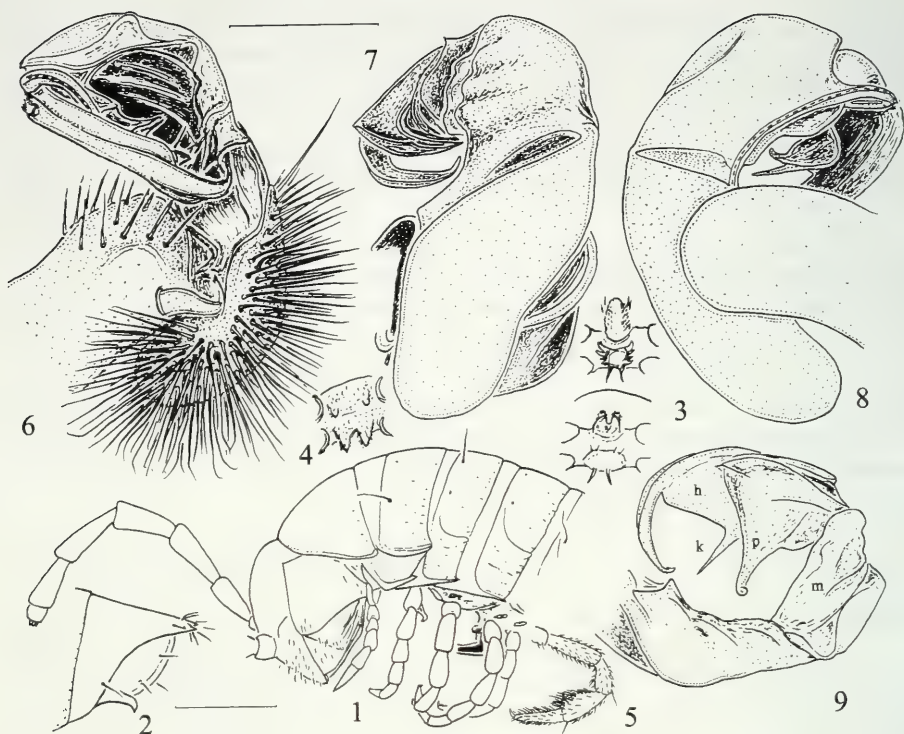
**Name:** To emphasize the presence of two dark paramedian stripes divided by a similarly wide but light axial stripe.

**Diagnosis:** Differs from congeners by the characteristic coloration, the strongly reduced paraterga visible only on segments 2-4, the presence of relatively short antennae, the deeply divided sternal lobe present between coxae 6 of the ♂, the subunciform tip of the hypoproct, the bifid tip of the epiproct, coupled with certain details of solenophore structure.

**Description:** Length 21-27 mm (♂, ♀), width of midbody metazona 1.9-2.1 (♂) or 2.1-2.8 mm (♀); ♀ usually larger and somewhat broader than ♂. Holotype *ca* 23 mm long and 2.0 mm wide. Coloration in alcohol pale yellowish brown to brown, with a characteristic pair of brown to dark brown paramedian stripes divided by an equally wide axial stripe of background coloration; legs and sterna yellowish gray, slightly paler than background coloration; tip of antennae pallid, penultimate antennomere dark brown; posterior half of body always somewhat paler than anterior one.

Body subcylindrical, not moniliform. Postcollar constriction faint, width of head = 5-16 > collum = 4 > 2 = 3; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae relatively short, slightly clavate, *in situ* reaching beyond segment 2 dorsally (Fig. 1), a little shorter in ♀.





FIGS 1-9

*Catharosoma bilineatum* sp. n., ♂ holotype: 1) anterior body portion, lateral view; 2) telson, lateral view; 3) sternal structures between coxae 4-7 (coxae 4 on top); 4) sternal structures between midbody coxae; 5) leg 12; 6-9) left gonopod, medial, ventral, lateral and ventromedial views, respectively. Scale bars 1.0 (1-5) and 0.25 mm (6-9).

Paraterga strongly reduced, only on segment 2 fully developed as low keels with a caudal tooth, discernible on segments 3 and 4 as arcuated sulci (Fig. 1), on following segments totally missing. Tegument smooth, shining, only rear parts of metazona often faintly rugulose. Limbus thin, caudal margin entire. Metaterga fully devoid of a transverse sulcus; setae medium-sized, often abraded, arranged 2+2 in a transverse line behind a shallow stricture between pro- and metazona. Ozopores lateral, opening level to metatergal surface *ca* 1/3 metazonital length away from caudal edge. Pleurosternal carinae shaped like narrow keels with a caudal spinule (Fig. 1) traceable until segment 16 (♀) or 17 (♂), on following segments wanting. Epiproct (Fig. 2) rather long, coniform, bifid, in ♂ a little longer than in ♀. Hypoproct (Fig. 2) subtriangular, tip pointed, unciform, directed ventrad; 1+1 paramedian setae at caudal edge considerably separated from each other. Paraterga, pleurosternal carinae and hypoproct uncus in ♂ a little more strongly developed than in ♀.

Sterna densely setose. Sternum between coxae 3 of ♂ with a paramedian, nearly contiguous pair of bunches of setae. Sternum between coxae 4 of ♂ with a prominent, linguiform, laterally setose outgrowth directed anteroventrad (Fig. 3); a similar but

much lower outgrowth between coxae 5 of ♂ (Fig. 3); a more or less prominent and deeply divided outgrowth between coxae 6 of ♂ poorly delimited caudally against a similar but less prominent bulge with peculiar paramedian bunches of setae between coxae 7 of ♂ (Fig. 3). Postgonopodial sterna with shorter (between anterior coxae) or longer (between posterior coxae), coniform, paramedian spines developed a little better in ♂ (Fig. 4) than in ♀.

Legs without tarsal brushes but densely setose ventrally; setation gradually thinning out toward telson; tibiae swollen ventrally and supporting characteristic brushes (Fig. 5) between leg-pair 9 until two last pairs. Legs in ♂ a little longer than in ♀, as usual becoming a little longer and slenderer toward telson. Each coxa 2 of ♂ with a prominent, somewhat sinuate, distoventral spine carrying a gonopore at base.

Gonopods (Figs 6-9) highly complex. Coxite elongate, subcylindrical, setose distoventrally; cannula normal. Telopodite strongly unciform, with a hypertrophied, as usual densely setose prefemoral part somewhat longer than femorite. A few undulations on ventrocaudal face and a few longitudinal ridges anterodorsally at base of solenophore. Solenophore coiled, ventrally with both a slightly folded base of lamina medialis (**m**) and a subtriangular parabasal lobe (**p**) similarly well-developed; **p** followed by a spine (**k**) supporting the tip of a flagelliform solenomere at base of a hyaline lobule (**h**), this lobule supporting the penultimate  $1/4$  extent of both lamina lateralis and lamina medialis; distalmost  $1/4$  extent of both laminae slender, unciform, free of support.

*Remarks:* Judging from the colour pattern and gonopod structure, this new species seems to be especially close to *C. mesoxanthum*, but both differ in size, in structure of the process between coxae 6 of the ♂, and in direction of the apical papillae on the epiproct (see also key below).

### *Catharosoma mahnerti* sp. n.

Figs 10-17

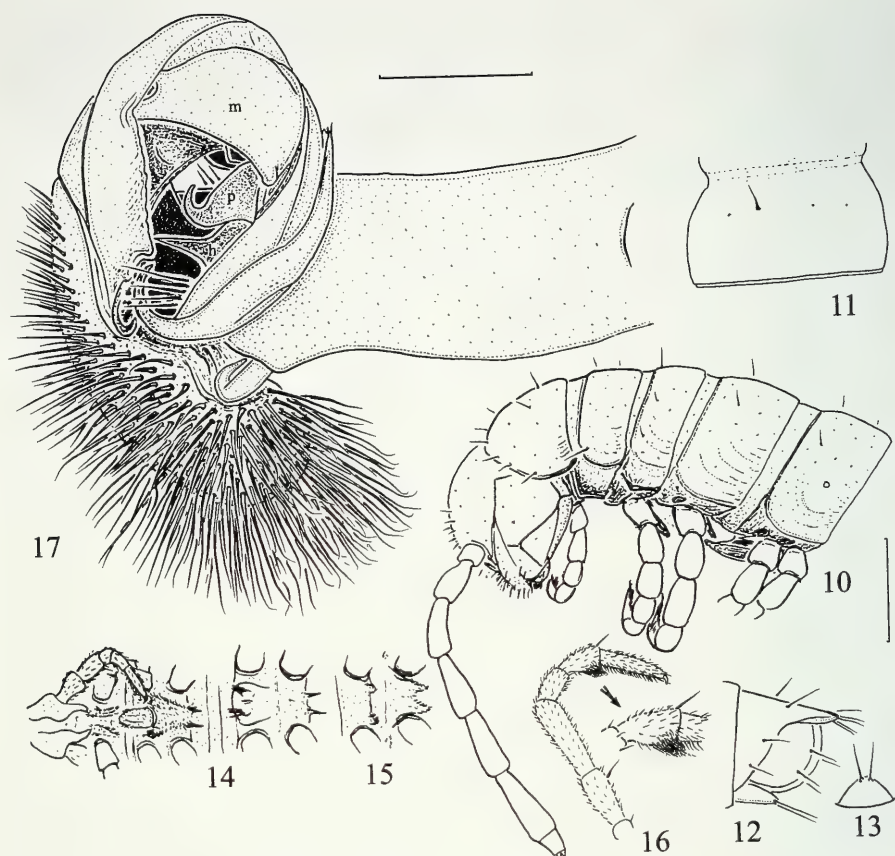
*Material:* Holotype ♂ (MHNG), Paraguay, Prov. Concepción, Estancia Laguna Negra, 15 km E of Paso Barreto, dead wood, 13.10.1985, leg. Expédition zoologique du Muséum de Genève. – Paratypes: 1 ♂, 2 ♀ ♀ (MHNG), 1 ♂, 1 ♀ (ZMUM), same locality, together with holotype; 1 ♂ (MHNG), Prov. Concepción, near mouth of Ao River, Trementina (Estancia Laguna Negra), forest, 13.10.1985, leg. Expédition zoologique du Muséum de Genève.

*Name:* Honours Dr Volker Mahner, who entrusted me this valuable material for study.

*Diagnosis:* Differs from congeners by the submoniliform body, the longer antennae, the absence of a distinct colour pattern and of an unciform hypoproct, the presence of two paramedian pilose ridges between coxae 3 of the ♂, and in certain details of gonopod structure.

*Description:* Length 20-23 mm (♂, ♀), width of midbody metazona 1.7 (♂) to 2.3-2.5 mm (♀); ♀ usually larger and somewhat broader than ♂. Holotype *ca* 20 mm long and 1.7 mm wide. Coloration in alcohol uniformly light brown to red-brown; only penultimate antennomere rather dark brown, tip of antenna pallid; legs paler, yellow-brown to brown.

Body subcylindrical, submoniliform. Postcollar constriction faint, width of head = 5-16 > collum = 4 > 2 = 3; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae medium-sized, slender, *in situ* reaching beyond segment 3 dorsally (Fig. 10), a little shorter in ♀. Paraterga



FIGS 10-17

*Catharosoma mahnerti* sp. n., ♂ paratype: 10) anterior body portion, lateral view; 11) metatergum 10, dorsal view; 12) telson, lateral view; 13) hypoproct, ventral view; 14) sternal structures between coxae 2-7 (legs 2 at left); 15) sternal structures between midbody coxae; 16) leg 15; 17) right gonopod, medial view. Scale bars 1.0 (10-16) and 0.2 mm (17).

strongly reduced, only on segment 2 fully developed as low keels devoid of a caudal tooth, discernible on segments 3 and 4 as arcuated lines, on segment 5 as modest swellings (Fig. 10), on following segments totally missing. Tegument smooth, shining, only metazona at places faintly rugulose. Limbus thin, caudal margin entire. Metaterga fully devoid of a transverse sulcus; setae short, often abraded, arranged 3+3 on segments 2 and 3, on following segments 2+2 in a transverse line behind a rather deep stricture between pro- and metazona (Fig. 11). Ozopores lateral, opening level to metatergal surface *ca* 1/3 metazonital length away from caudal edge (Fig. 10). Pleurosternal carinae like narrow keels with a caudal spinule (Fig. 10) traceable until segment 16 (♀) or 17-18 (♂), onward wanting. Epiproct (Fig. 12) rather long, coniform, faintly emarginate at tip in dorsal view, in ♂ a little longer than in ♀. Hypoproct



(Figs 12, 13) subtriangular, tip narrowly rounded, nearly pointed, straight; 1+1 paramedian setae at caudal edge poorly separated. Paraterga, pleurosternal carinae and hypoproct a little more strongly developed in ♂ than in ♀.

Sternal structure (Figs 14, 15) much like in *C. bilineatum* sp. n., but with two paramedian pilose ridges between coxae 3 of ♂ and paramedian bunches of setae on poorly developed knobs between coxae 6 of ♂.

Legs without tarsal brushes but densely setose ventrally; setation gradually thinning out toward telson; tibiae swollen ventrally and supporting characteristic brushes (Fig. 16) between leg-pair 7 and two last pairs. Legs in ♂ a little longer than in ♀, as usual becoming a little longer and slenderer toward telson. Each coxa 2 of ♂ with a strong, distoventral, sigmoid, apically pointed process carrying a gonopore at base (Fig. 14).

Gonopods (Fig. 17) highly complex, much like in *C. bilineatum* n. sp., but coxite more elongate, telopodite circular and elongate, while solenophore ventrally with a much larger, hyaline lobe/base of lamina medialis (**m**), an apically strongly unciform parabasal lobe (**p**) followed by a spiniform process supporting a flagelliform solenomere at base of a hyaline lobule (**h**), this lobule supporting the penultimate 1/4 extent of both lamina lateralis and lamina medialis; distalmost 1/4 extent of both laminae likewise slender, unciform, free of support.

*Remarks:* Judging from the particularly elongate gonopod telopodite, which includes the femorite, this new species seems to be especially close to *C. curitibense* and *C. intermedium*, but the circular telopodite and the shape of its individual elements in *C. mahnerti* sp. n. are quite characteristic.

At first Jeekel (1963) merged *Catharosoma* and *Mestosoma* together, but later (1968) he separated them on the account of the apparently more apomorphic character states observed in *Mestosoma* species. This viewpoint has also been shared by Hoffman (1980).

### *Broelemannopus minutus* sp. n.

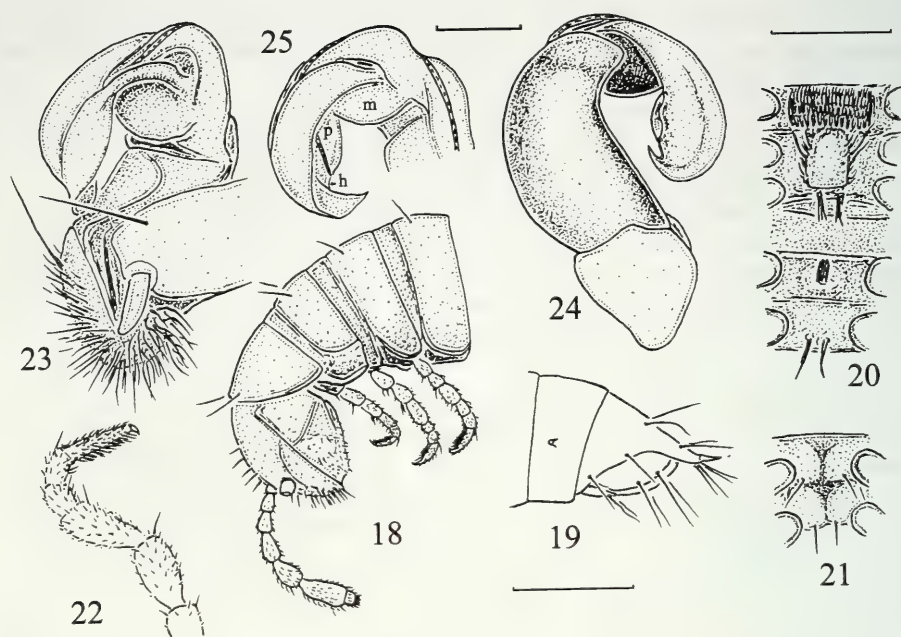
Figs 18-25

*Material:* Holotype ♂ (MHNG), Paraguay, Alto Paraná Prov., Forestry School, 12 km S of Puerto Presidente Stroessner, soil sample 1, 04.1983, leg. C. Dlouhy. – Paratypes: 20 ♂♂, 22 ♀♀, 2 juv. (MHNG), 2 ♂♂, 2 ♀♀ (ZMUM), same locality, together with holotype; 1 ♂, 1 ♀ (MHNG), same locality, soil sample 8, 04.1984; 2 ♂♂, 1 ♀ (MHNG), same locality, soil sample 24, 06.1984; 3 ♂♂ (MHNG), same locality, soil sample 10, 05.1984; 1 ♀, 3 juv. (MHNG), same locality, soil sample 22, 25.06.1984; 1 ♂, 1 ♀ (MHNG), same locality, soil sample 25, 25.06.1984; 1 ♂ (MHNG), same locality, soil sample 7, 04.1984; 1 ♂, 3 juv. (MHNG), same locality, soil sample 23, 25.06.1984; 2 ♂♂ (MHNG), same locality, soil sample 3, 21.05.1984; 1 ♂, 1 ♀, 1 juv. (MHNG), same locality, soil sample 13, 04.1984; 1 ♂, 1 ♀, 1 juv. (ZMUM), same locality, soil sample 30, 04.1984; 14 ♂♂, 17 ♀♀ (MHNG), same locality, soil sample 12, 04.06.1984, all leg. C. Dlouhy.

*Name:* To emphasize the small body size.

*Diagnosis:* Differs from congeners by the particularly small size, the especially strongly reduced paraterga visible only on segment 2, the lack of transverse metatergal sulci, the absence of a distinct colour pattern and of an unciform hypoproct, and in certain details of solenophore structure.

*Description:* Length 7-9 mm (♂, ♀), width of midbody metazona 0.6-0.7 (♂) to 0.8-0.9 mm (♀); ♀ usually larger and somewhat broader than ♂. Holotype *ca* 8 mm



FIGS 18-25

*Broelemannopus minutus* sp. n., ♂ paratype: 18) anterior body portion, lateral view; 19) caudal body portion, lateral view; 20) sternal structures between coxae 3-7 (coxae 3 on top); 21) sternal structures between midbody coxae; 22) leg 10; 23-25) right gonopod, medial, lateral and anterodorsal views, respectively. Scale bars 0.5 (18-19), 0.25 (20-22) and 0.1 mm (23-25).

long and 0.7 mm wide. Coloration in alcohol uniformly brown to red-brown, only juveniles, antennae and legs paler, yellow-brown to brown; tip of antenna pallid.

Body subcylindrical, not moniliform. Postcollar constriction faint, width of head > collum > 2 ≥ 3 < 4 < 5-16; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae medium-sized, slender, *in situ* reaching the end of segment 2 dorsally (Fig. 18), a little shorter in ♀. Paraterga strongly reduced, only present as low lines devoid of a caudal tooth on segment 2 (Fig. 18), on following segments totally missing. Tegument smooth, shining. Limbus thin, caudal margin entire. Metaterga fully devoid of a transverse sulcus; setae relatively long, sometimes abraded, arranged 2+2 on segment 2, on following segments 1+1 in a transverse line behind a shallow stricture between pro- and metazona (Fig. 18). Ozopores lateral, opening level to metatergal surface *ca* 1/3 metazonal length away from caudal edge. Pleurosternal carinae like narrow arcuated lines (Fig. 18) traceable until segment 16 (♀) or 17 (♂), on following segments wanting. Epiproct (Fig. 19) rather long, coniform, in ♂ a little longer than in ♀, tip with a strong claw-shaped uncus directed dorsocaudally. Hypoproct (Fig. 19) subtriangular, tip narrowly rounded, nearly pointed, straight; 1+1 very long paramedian setae at caudal edge poorly separated from each other. Paraterga, pleurosternal carinae, epi- and hypoproct in ♂ a little more strongly developed than in ♀.

Sterna mostly sparsely setose. Sternum between coxae 3 of ♂ furnished with several transverse rows of relatively small, subcontiguous, scale-like structures on a boss (Fig. 20). Sterna between coxae 4 and 5 of ♂ with a very prominent, linguiform, laterally setose outgrowth directed anteroventrad (Fig. 20); a paramedian pair of bunches of setae between coxae 5 and 7 of ♂ (Fig. 20); a central, compact and thicker bunch of setae on a swelling between coxae 6 of ♂ (Fig. 20). Postgonopodial sterna without modifications (Fig. 21).

Legs without tarsal brushes but densely setose ventrally, without modifications (Fig. 22); setation gradually thinning out toward telson; legs in ♂ a little longer than in ♀, as usual becoming a little longer and slenderer toward telson. Each coxa 2 of ♂ nearly unmodified, with a small distoventral cone surmounted by a gonopore.

Gonopods (Figs 23-25) not particularly complex. Solenophore ventrally with a distinct but not hypertrophied, rounded, hyaline lobe/base of lamina medialis (**m**); another simple, parabaasal lobe (**p**) supporting the tip of a flagelliform solenomere at base of a smaller hyaline lobule (**h**), the latter supporting the subterminal part of both lamina lateralis and lamina medialis; distalmost extent of both laminae very short and rather broad, subunciform and subtruncate.

*Remarks:* Judging from the particularly small size, the similarly uncigerous epiproct, the paraterga present on segment 2 only, as well as from several other traits, including those of the gonopod, the new species seems to be especially close to *B. ibitiensis*, from Monte Alegre, São Paulo State, Brazil (Schubart, 1945a). The distinctions of *B. minutus* lie in the total absence of sternal cones on postgonopodial segments of the ♂, as well as the presence of a smaller and differently armed lobe between coxae 3 of the ♂, and of a smaller lobe **p** on the solenophore (see also key below). *B. ibitiensis* has only tentatively been placed in *Broelemannopus* (see Jeekel, 1963) but, since this species shows especially close affinities with *B. minutus* sp. n., there can no longer be any doubt that both are congeners best to be assigned to *Broelemannopus*.

In general the genus *Broelemannopus* is so poorly distinguished from *Mestosoma* that at first Jeekel (1963) merged these two genera together and treated the former as only a species group of the latter. However, later (1968) he separated them on the basis of certain apomorphies observed in both (see key below), a view which is also shared by Hoffman (1980).

### *Mestosoma simplex* sp. n.

Figs 26-32

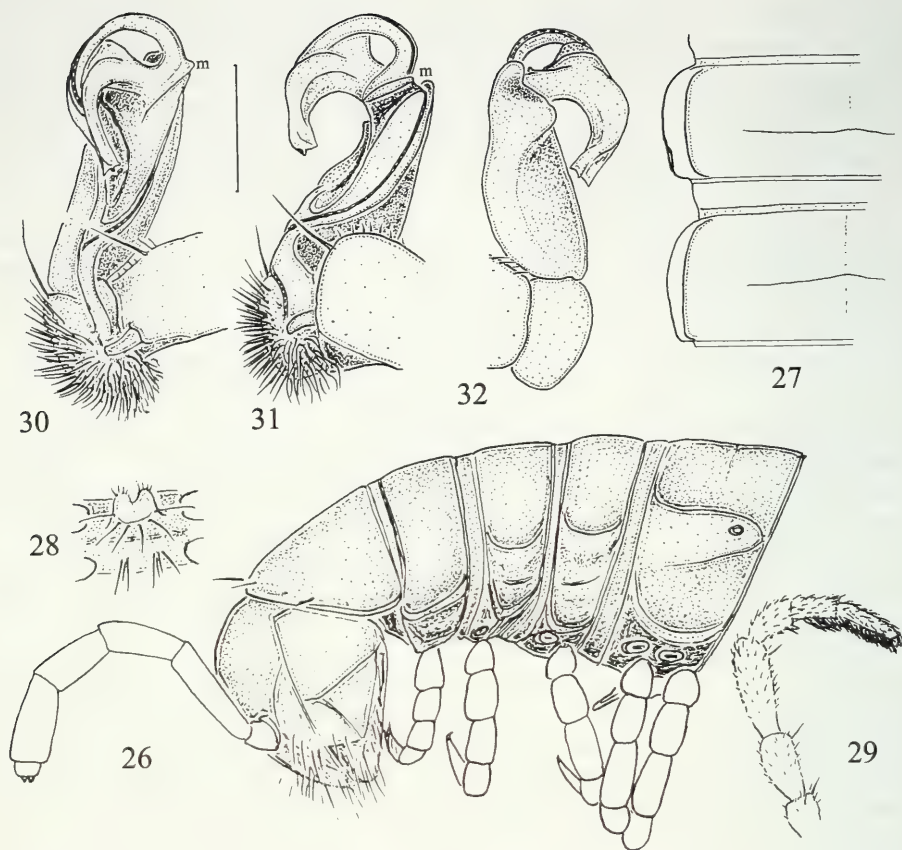
*Material:* Holotype ♂ (MHNG), Paraguay, Prov. Cordillera, 5 km N of Emboscada, Rio Piribebuy, forest with bromeliads, dead wood and leaves, 05.04.1985, leg. Expédition zoologique du Muséum de Genève. – Paratype: 1 juv. (MHNG), same locality, together with holotype.

*Name:* To emphasize the only slightly modified legs of the ♂ and the relatively simple gonopod structure.

*Diagnosis:* Differs from congeners by the relatively small size, the only slightly modified legs of the ♂, and the relatively simple solenophore structure.

*Description:* Length of holotype ca 12 mm, width of midbody metazona 1.5 mm. Coloration in alcohol uniformly light red-brown, anterior body portion





FIGS 26-32

*Mestosoma simplex* sp. n., ♂ holotype: 26) anterior body portion, lateral view; 27) left halves of segments 10 and 11, dorsal view; 28) sternal structures between coxae 4 and 5 (coxae 4 on top); 29) leg 15; 30-32) right gonopod, medial, submedial and lateral views, respectively. Scale bar 0.6 (26-29) and 0.3 mm (30-32).

slightly more intensely reddish; penultimate antennomere darker brown, tip of antenna pallid; legs paler, yellow-brown.

Body strongly losomoid, not moniliform, with poorly developed but evident paraterga. Postcollar constriction apparent, width of head = collum  $> 2 = 4 \ll 5-16$ ; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae medium-sized, slightly clavate, *in situ* reaching beyond segment 2 dorsally (Fig. 26), a little shorter in juvenile. Paraterga 2 and 5-19 delimited by an evident sulcus not only dorsally but also ventrocaudally (Fig. 26), all set low, considerably larger on pore-bearing segments than on poreless ones (Fig. 27), only on segments 18 and 19 slightly projecting beyond rear tergal contour. Tegument smooth and shining. Limbus thin, caudal margin entire. Metaterga 5-17 with a faint but

apparent transverse sulcus far from reaching base of paratergum, the sulcus being very slightly sinuate anteromedially; axial impression on metaterga interrupted in the middle, barely visible; tergal setae untraceable (Figs 26, 27). Stricture between pro- and metazona thin and shallow (Figs 26, 27). Ozopores lateral, lying on paraterga at  $ca\ 1/4$  metazonal length away from caudal edge (Figs 26, 27). Pleurosternal carinae like narrow keels delimited by a sulcus dorsally, devoid of a caudal spinule (Fig. 26), traceable until segment 17, on further segments wanting. Epiproct rather long, coniform, narrowly truncate at tip in dorsal view, in ♂ a little longer than in juvenile. Hypoproct roundly triangular, tip evidently rounded, straight; 1+1 paramedian setae at caudal edge rather strongly separated from each other.

Sterna modestly setose, mainly unmodified but both with an evident, deeply emarginate, setose, linguiform outgrowth directed anteroventrally between coxae 4 of ♂ and with a paramedian pair of bunches of setae between coxae 5 of ♂ (Fig. 28).

Legs only slightly modified, in ♂ with dense tarsal brushes starting from leg-pair 1 and with dense tibial brushes starting from leg-pair 2 (Fig. 29), both these brushes thinning out toward telson but absent only from last two leg-pairs. Each coxa 2 of ♂ with a low distoventral cone bearing a gonopore.

Gonopods (Figs 30-32) relatively simple. Coxite subcylindrical, not particularly elongate, sparsely setose distoventrally. Telopodite subfalcate, a densely setose prefemoral part normal in shape, much shorter than femorite. Solenophore unciform, somewhat constricted at base, relatively stout and simple; lobe **m** at base of both solenomere and lamina medialis highly inconspicuous, ledge-shaped, lamina lateralis slightly better developed than lamina medialis, tips of both subtruncate.

*Remarks:* Due to the basally strongly constricted solenophore, *M. simplex* sp. n. joins group III in the sense of Jeekel (1963), which has hitherto been known to comprise only three species, one each from the Brazilian states of Pernambuco, Alagoas and São Paulo. However, the new species differs in its smaller size, in the absence of femoral and some sternal modifications in the ♂, and in the particularly simple gonopod structure.

### *Mestosoma crassipes* sp. n.

Figs 33-42

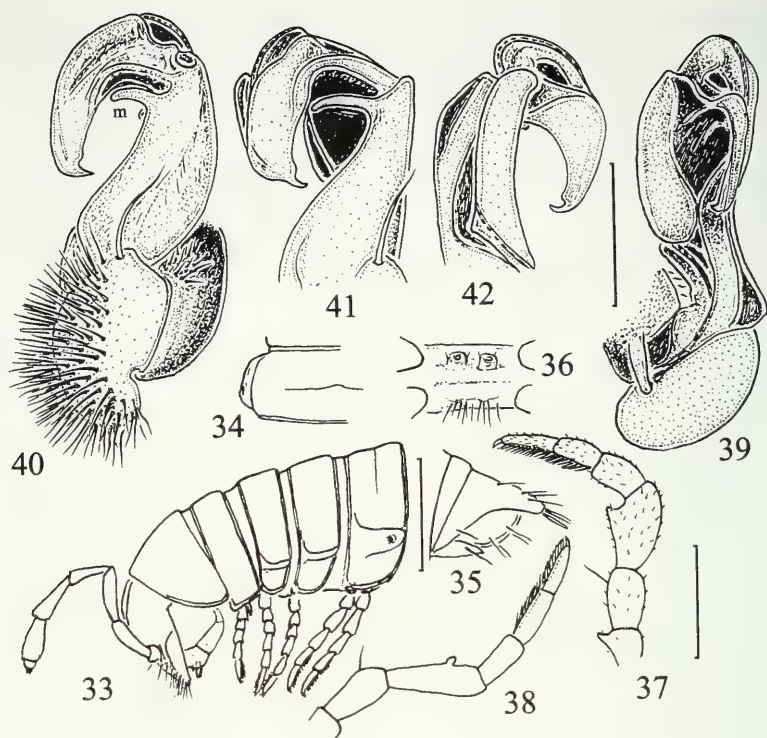
*Material:* Holotype ♂ (MHNG), Paraguay, Prov. Concepción, Ao. Tagatya-mi, small grove, near "gué", sifted litter, 23.10.1985, leg. Expédition zoologique du Muséum de Genève.

*Name:* To emphasize the modified and inflated legs of the ♂.

*Diagnosis:* Differs from congeners by the relatively small size, the conspicuously modified legs of the ♂, and by the relatively complex gonopod structure.

*Description:* Length of holotype  $ca\ 12$  mm, width of midbody metazona 1.3 mm. Coloration in alcohol uniformly light brown; antennae brown, penultimate antennomere darker brown; tip of antenna pallid; legs slightly paler.

Body strongly losomoid, not moniliform, much like in *M. simplex* sp. n. Post-collar constriction apparent, width of head ? collum =  $4 > 2 = 3 < 5 < 6(7) - 16$ ; on segments 17-20 trunk gradually and gently tapering toward telson both in width and in height. Antennae medium-sized, slightly clavate, *in situ* reaching beyond segment 2 dorsally (Fig. 33). All paraterga set low, delimited by an evident sulcus not only dorsally but also ventrally to ventrocaudally (Fig. 33), on segment 19 particularly flat



FIGS 33-42

*Mestosoma crassipes* sp. n., ♂ holotype: 33) anterior body portion, lateral view; 34) left half of metatergum 10, dorsal view; 35) caudal body portion, lateral view; 36) sternal structures between coxae 3 and 4 (coxae 3 on top); 37) leg 7; 38) leg 9; 39-42) left gonopod, submedial, sublateral, ventrolateral and anterodorsal views, respectively. Scale bars 1.0 (33-35), 0.5 (36-38) and 0.3 mm (39-42).

in lateral view, considerably larger on pore-bearing segments than on poreless ones (Figs 33, 34), never projecting beyond rear tergal contour. Tegument smooth and shining. Limbus thin, caudal margin entire. Metaterga 5-18 with a faint but apparent transverse sulcus far from reaching base of paratergum, the sulcus being slightly sinuate anteromedially; axial impression on metaterga wanting; tergal setae untraceable (Figs 33, 34). Stricture between pro- and metazona thin and shallow (Figs 33, 34). Ozopores lateral, lying on paraterga at  $ca \frac{1}{4}$  metazonal length away from caudal edge (Figs 33, 34). Pleurotergal carinae like narrow keels delimited by a sulcus dorsally, devoid of a caudal spinule (Fig. 33), traceable until segment 17, on following segments wanting. Epiproct rather long (Fig. 35), coniform, narrowly truncate at tip in dorsal view. Hypoproct triangular, tip pointed, straight; 1+1 paramedian setae at caudal edge widely separated from each other (Fig. 35).

Sterna mainly modestly setose, postgonopodial ones unmodified, pregonopodial ones with a paramedian pair of bunches of setae on small cones between coxae 3 and



4 of ♂ (Fig. 36); sterna between coxae 5-7 of ♂ concave and with some particularly long setae (like in Fig. 36).

Legs modified, with dense tarsal brushes starting from leg-pair 1 and with dense tibial brushes starting from leg-pair 2 (Figs 37, 38), both these brushes thinning out toward telson and virtually absent only from last two leg-pairs. Femora 4-6 conspicuously inflated and each with an evident distoventral tooth. Legs 7 (Fig. 37) with a distoventral cone on each coxa and a little less strongly incrassate femora, the tooth situated more ventro-apically. Femora 9-11 (Fig. 38) nearly normal, ventral knobs in distal one-third gradually disappearing toward leg-pair 12. Each coxa 2 with a low distoventral cone bearing a gonopore.

Gonopods (Figs 40-42) somewhat more complex than in the previous congener, especially so due to a longitudinal sulcus on dorsal face of femorite, a digitiform process (**m**), not a ledge-shaped structure lying at base of lamina lateralis, as well as a short, unciform and pointed solenophore tip.

*Remarks:* This new species seems to be particularly close to *M. alticola* and to a few other congeners possessing a small but evident process (**m**) at base of both the solenophore and solenomere (see Attems, 1937). The colour pattern in *M. crassipes* sp. n. resembles that of *M. femorale*, yet the gonopod structure is quite different (see Schubart, 1943). Due to the presence of two small tubercles between coxae 3 of the ♂ and an attenuated tip of the solenophore, the new species is similar to *M. perfidum*, but the latter species is larger (17-18 mm long and 1.9-2.0 mm wide versus 12 and 1.3 mm), and their gonopods are very different as well.

## IDENTIFICATION KEYS

### KEY TO TRIBES AND GENERA OF PARADOXOSOMATIDAE OCCURRING IN PARAGUAY AND ADJACENT AREAS

- 1 Paraterga strongly developed, wing-like. (Introduced, normally synanthropic species) ..... 2
- Paraterga poorly developed to missing (Figs 1, 10, 18, 26, 33) (Tribe Catharosomatini, autochthonous species) ..... 4
- 2 Metaterga densely papillate and setose; a bituberculate process between coxae 4 of ♂; femora 4-7 of ♂ each with a ventro-parabasal knob; gonopod femorite stout, solenophore with a large basal prong ventrally ..... Tribe Sulciferini: *Chondromorpha* (*C. xanthotricha*)
- Metaterga not papillate, at most poorly setose; sternum between coxae 4 of ♂ without process; legs of ♂ without such femoral tubercles; gonofemorite not so stout, almost as long as to longer than solenophore ..... 3
- 3 Caudal corners of paraterga surpassing rear tergal contour only on caudalmost segments (16-19); gonofemorite relatively short, distinctly broadened distally; solenophore bifid, at base with a long apical process as well as a prong and a lobe ventrally . . . Tribe Sulciferini: *Oxidus* (*O. gracilis*)
- Caudal corners of paraterga surpassing rear tergal contour on all body segments; gonopod telopodite very slender and simple, rod-shaped; gonofemorite slightly longer than solenophore, latter without outgrowths at base but with a minute lobule at tip ..... Tribe Orthomorphini: *Orthomorpha* (*O. coarctata*)

- 4 Gonopod devoid of a solenophore, solenomere free ..... 5
- Gonopod with a solenophore sheathing and supporting a flagelliform solenomere ..... 9
- 5 Gonopod telopodite extremely simple, subfalcate to subcircular, devoid of any outgrowths at base of a subflagelliform solenomere ... *Gonodrepanum*
- Gonopod telopodite more complex, with 1–2 processes or dilatations in femoral or postfemoral region ..... 6
- 6 Gonofemorite with a large, medial, lobuliform dilatation; solenomere with a small tooth near tip ..... *Mogyella* (*M. nana*)
- Gonofemorite without a large dilatation but sometimes with a tooth distally or parabasally; 1-2 dilatations or processes at base of solenomere, latter sometimes stout and thick ..... 7
- 7 Body small, 0.7 mm wide. Gonopod telopodite subfalcate, much like in *Gonodrepanum*; femorite with a small ventro-parabasal tooth; a small but evident, elongated, subtriangular dilatation/lobe fused ventrally at base with a flagelliform solenomere ..... *Pseudogonodrepanum* (*P. scitum*)
- Body medium-sized, >1.0 mm wide. Gonopod telopodite mostly suberect, usually with two independent teeth/outgrowths at base of solenomere ..... 8
- 8 Entire gonopod telopodite suberect, with an evident process at base of a rather thick, sometimes bifid solenomere; a setose, linguiform, sternal process between coxae 4 of ♂ ..... *Habrodesmoides*
- Only gonopod femorite elongated and suberect; solenomere subflagelliform and unciform, acuminate, at base with two relatively small teeth/outgrowths; sternal process between coxae 4 of ♂ either missing or represented by two paramedian knobs ..... *Ologonosoma*
- 9 Solenophore simple, subflagelliform, acuminate, supporting a similarly flagelliform solenomere. .... 10
- Solenophore complex, sometimes with a process or lobe at base, usually consisting of several more or less folded lobes/laminae, almost entirely sheathing a flagelliform solenomere ..... 11
- 10 Body width 0.7 mm. Prefemoral (setose) part of gonopod much shorter than acropodite; femorite with a conspicuous lamella on medial side; both solenophore and solenomere somewhat reduced, about half as long as femorite ..... *Mogyosoma* (*M. hamatum*)
- Body width 1.1-1.5 mm. Prefemoral portion of gonopod elongated, nearly as long as acropodite; femorite without a lobe on medial side; both solenophore and solenomere longer than femorite ..... *Gonodrepanoides* (*G. travassosi*)
- 11 Solenophore relatively simple but with a large lateral branch/process at base ..... *Promestosome* (*P. boggianii*)
- Solenophore more complex, usually consisting of several lobes but devoid of a large lateral branch at base ..... 12
- 12 Sternal cones usually present (Figs 4 & 15); each coxa 2 of ♂ with a strong distoventral process carrying a gonopore (Figs 1 & 14); tibiae of

- ♂ usually conspicuously inflated (Figs 5 & 16). Prefemoral (densely setose) portion of gonopod hypertrophied, about as long as femorite ..... *Catharosoma*
- Sternal cones usually absent; normally each coxa 2 of ♂ with a small cone carrying a gonopore; tibiae of ♂ not inflated. Prefemoral portion of gonopod normal, shorter than femorite ..... 13
  - 13 Tarsal brushes often absent even in ♂; sternite between coxa 3 of ♂ with a conspicuous comb- or tongue-shaped structure (Fig. 20); sternite between coxae 5 of ♂ with a particularly large process directed antero-ventrally and covering a boss or protuberance if any between coxae 4 ..... *Broelemannopus*
  - Tarsal brushes in ♂ mostly present; sternite between coxa 3 of ♂ usually without protuberances; a particularly large process directed anteroventrally and placed between coxae 4, not 5, of ♂ ..... *Mestosoma*

KEY TO *BROELEMANNOPUS* SPECIES OF PARAGUAY AND ADJACENT AREAS

- 1 Body of adult < 10 mm long and ≤ 1.0 mm wide; epiproct topped with a prominent claw-shaped uncus directed slightly dorsad (Fig. 19); cones absent at least between front coxae of postgonopodial sterna ..... 2
- Body ≥ 14 mm long and ≥ 1.6 mm wide; epiproct without central uncus at tip, latter usually bifid; sternal cones in ♂ present between both pairs of legs of each segment; Brazil ..... 3
- 2 Lobe between coxae 4 and 5 of ♂ linguiform, entire (Fig. 20); sternal cones on midbody segments of ♂ totally absent (Fig. 21); solenophore lobe **p** small (Figs 23–25); Paraguay ..... *B. minutus*
- Lobe between coxae 4 and 5 of ♂ divided distally; sternal cones in ♂ present between posterior coxae of segments 8–18; solenophore lobe **p** large; São Paulo State, Brazil ..... *B. ibitiensis*
- 3 Body 1.6–2.2 mm (♂) or 1.6–2.4 mm wide (♀). Paraterga traceable as low arcuated sulci on segments 2–4, on following segments only as slight impressions visible near caudal margin; pleurosternal carinae traceable until segment 14 ..... *B. pirassunungensis*
- Body 2.3–3.3 mm wide (♂, ♀). Each paratergite traceable as a low arcuated crest at least on segment 2; pleurosternal carinae visible until segment 15 ..... 4
- 4 Sternal lobe between coxae 3 of ♂ comb-shaped, entire distally; coxae 2–6 of ♂ each with a distoventral coniform process; central protuberance between coxae 7 of ♂ absent; distal end of solenophore not divided ..... *B. escaramucensis*
- Sternal lobe between coxae 3 of ♂ linguiform, deeply incised distally; only coxae 2 and 3 of ♂ each with a coniform process; central protuberance between coxae 7 of ♂ present; distal end of solenophore deeply divided into two large lobes, **p** being one of these ..... *B. glabratus*



KEY TO *CATHAROSOMA* SPECIES

- 1 Sternum between coxae 6 of ♂ with a single, undivided process or swelling ..... 2
- Sternum between coxae 6 of ♂ either with a deeply divided process or with two distinct paramedian processes, or with two paramedian knobs with bunches of long setae ..... 5
- 2 Hypoproct tip unciform; gonopod femorite with a prominent, subtriangular, distal lobe ..... *C. digitale*
- Hypoproct tip straight; gonofemorite without a prominent, subtriangular, distal lobe ..... 3
- 3 Body width about 2.2 mm; no sternal modifications except pilosity between coxae 5 of ♂; tip of solenophore simple, like a broad and subacuminate lobe ..... *C. mixtum*
- Body width 3.0-3.2 mm; a swelling and/or a paramedian pair of knobs between coxae 5 of ♂; tip of solenophore more complex ..... 4
- 4 Paraterga 2 like swellings, paraterga 3 and 4 sulciform; light subtriangular spots on posterior parts of proterga and on anterior parts of metaterga against a dark background; apical piece of solenophore short, acuminate ..... *C. peraccae*
- Paraterga 2-4 like low crests; background coloration pale yellowish with a wide castaneous axial stripe; apex of solenophore very broad and of rather irregular shape ..... *C. mesorpinum*
- 5 Even paraterga 2 expressed as sulci; no sternal modifications except pilosity between coxae 5 of ♂ ..... *C. myrmekurum*
- Crest-like paraterga present at least on segment 2 (Figs 1 & 10), often ridge/crest-like even on segments 2-4; sternal modifications present between coxae 5 of ♂ ..... 6
- 6 Paraterga 2-4 distinctly crest-like, onward sulciform on segments 5, 7, 9 and 10; a distinct bilobed process present between coxae 3 of ♂ ..... *C. palmatum*
- Paraterga even more poorly developed, totally untraceable on segments behind 4<sup>th</sup> ..... 7
- 7 Body about 12 mm long and 1.3 mm wide; coxae 2 of ♂ produced distally into a small mammiform process; gonofemorite with a medio-parabasal digitiform process ..... *C. curitibense*
- Body width ≥ 1.7 mm; coxae 2 of ♂ usually produced into a more or less prominent process (Fig. 14); gonofemorite devoid of such a process ..... 8
- 8 Hypoproct unciform, its tip directed ventrad ..... 9
- Hypoproct tip straight ..... 12
- 9 Dorsum rather dark, red-brown, with two yellowish paramedian stripes; pleurosternal carinae visible only until segment 15 ..... *C. taeniatum*
- Dorsum pale but with two dark, brownish paramedian stripes; pleurosternal carinae visible at least until segment 16 ..... 10
- 10 Body of ♂ 1.9-2.1 mm wide; a large and deeply incised process present between coxae 6 of ♂ (Fig. 3) ..... *C. bilineatum*

- Body width  $\geq 2.6$  mm; only a pair of small paramedian knobs between coxae 6 of  $\delta$  ..... 11
- 11 Apical papillae on epiproct acuminate, elongate and directed distodorsad; gonofemorite strongly broadened distad ..... *C. mesoxanthum*
- Apical papillae on epiproct small, simple, inconspicuous; gonofemorite slender ..... *C. intermedium*
- 12 A paramedian pair of low setigerous crests present between coxae 3 of  $\delta$ ; gonopod telopodite elongate and circular (Fig. 17) ..... *C. mahnerti*
- At most a paramedian pair of bunches of setae present between coxae 3 of  $\delta$ ; gonopod telopodite falcate and stout ..... 13
- 13 A single protuberance between coxae 5 of  $\delta$  and a paramedian pair of conical processes between coxae 6 of  $\delta$  ..... *C. palustre*
- Two setigerous knobs on a swelling between coxae 5 of  $\delta$  and either a swelling or a paramedian pair of spinules between coxae 6 of  $\delta$  ..... 14
- 14 Body width 2.0-2.3 ( $\delta$ ) to 2.5 mm ( $\varphi$ ); lobe **p** of solenophore ancoriform and bifid ..... *C. paraguayense*
- Body width 2.6 mm ( $\delta$ ); tip of lobe **p** of solenophore blunt, devoid of teeth ..... *C. hoffmani*

KEY TO *GONODREPANUM* SPECIES

- 1 Coloration of adults normally castaneous brown with a wide, uninterrupted, axial, contrastingly creamy stripe; Rio de Janeiro, Brazil ..... 2
- Coloration uniformly castaneous to black, usually devoid of a contrastingly pallid stripe, or axial stripe/line thin and interrupted; Argentina and/or Brazil ..... 3
- 2 Smaller, only known from  $\varphi$ : 16-18 mm long and 1.8-2.0 mm wide; clear sulci in place of paraterga 2-4 ..... *G. flavolineatum*
- $\varphi$  18-21 mm long and 2.2-2.4 mm wide,  $\delta$  15-16 mm long and 1.5-1.6 mm wide; paraterga on segment 2 like crests, on segments 3 and 4 like clear sulci, on following segments like striae; paramedian pairs of setigerous protuberances present between coxae 3-5 of  $\delta$  ..... *G. torresae*
- 3 Body particularly slender:  $\delta$  20 mm long and 1.2 mm wide. Dorsum and sides uniformly blackish; paraterga 2-4 crest-like, on following segments sulciform; sternal cones absent; Brazil and Argentina ..... *G. drepanephoron*
- Body neither so long ( $\leq 14$  mm even in  $\varphi$ ) nor so slender. Coloration of adults usually castaneous, sometimes yellowish; paraterga represented by sulci at most; sternal cones present; Brazil ..... 4
- 4 Epiproct topped with two long, claw-shaped, diverging unci directed dorsocaudad; a pale axial stripe/line absent ..... 5
- Epiproct without such unci; a pale, axial, interrupted stripe/line usually present ..... 6
- 5 Body 12-14 mm long and 1.3-1.7 mm wide; a small ventral tubercle present only on femora 3 and 4 of  $\delta$ ; sternal protuberance between coxae

- 3 of ♂ bifid, sterna between coxae 4 and 5 devoid of protuberances; solenomere subcircular . . . . . *G. grajahuense*
- Body 9-12 mm long and 1.0-1.3 mm wide; a distoventral tubercle present/traceable on femora 3-9 of ♂; median sternal protuberances present between coxae 3-5 of ♂; solenomere regularly and gently subfalcate . . . . . *G. furcatum*
- 6 Body about 14 mm long and 1.3-1.5 mm wide. Metaternal sulci absent; femora of ♂ not modified; a large median process with two knobs behind and between coxae 4 of ♂; solenomere relatively short and suberect; Santa Catarina, Brazil . . . . . *G. levisetum*  
(*G. levisetum* var. *coniferum* seems to only represent a colour form distinguished by a yellowish body devoid of a pattern)
- Body 11-12.5 mm long and 1.1 mm wide. Metaternal sulci light but present; a pair of diverging processes between coxae 5 of ♂; solenomere relatively long, subcircular; Rio de Janeiro, Brazil . . . . . *G. falciferum*

#### KEY TO *HABRODESMOIDES* SPECIES OF PARAGUAY AND ADJACENT AREAS

- 1 Paraterga replaced by a low arcuated ridge on segment 2, by sulci on segments 3 and 4; pleurosternal carinae traceable until segment 18; a small protuberance present between coxae 5 of ♂; solenomere retrorse, with a slender, subfalcate, simple process at base . . . . . *H. costalimai*
- Segments 2-18 with only slight sulci/striae in place of paraterga; pleurosternal carinae present on segments 2-7; sternite between coxae 5 of ♂ devoid of a protuberance; solenomere directed distoventrad, process at its base massive, stout and branched . . . . . *H. perturbans*

#### KEY TO *MESTOSOMA* SPECIES OF PARAGUAY AND ADJACENT AREAS

- 1 Sterna between coxae (3)4-6(7) of ♂ each with a more or less distinct median process or protuberance; sternal cones in ♂ absent . . . . . 2
- At least some of these sterna devoid of a protuberance; sternal cones in ♂ often present . . . . . 5
- 2 Body width  $\geq 2.3$  mm; metaternal sulcus present on segments subsequent to 5<sup>th</sup>; no single sternal process between coxae 6 and 7 of ♂ . . . . . 3
- Body width  $\leq 1.5$  mm (♂); metaternal sulci absent; a single, prominent, sternal process between coxae 6 and 7 of ♂; Bolivia . . . . . 4
- 3 Coloration uniformly brownish; sternal processes or protuberances present between coxae 3-6 of ♂; Rio de Janeiro, Brazil . . . . . *M. carioca*
- With a wide pale axial stripe against a dark olive-brown background; sternal process present between coxae 4 of ♂, only protuberances or swellings between coxae 5 and 6 in ♂; Bolivia . . . . . *M. schindleri*
- 4 Body width 1.0 mm (♂); colour pattern in adults indistinct, body uniformly yellowish; femora 3-5 of ♂ each with a ventral tubercle . . . *M. alticola*
- Body width about 1.5 mm (♂); a wide, pale, axial stripe against a chocolate-brown background; femora in ♂ apparently without ventral tubercles . . . . . *M. boliviae*



- 5 Sterna of segment 6 in ♂ with a pair of processes at anterior border, sterna of segment 5 of ♂ devoid of processes; neither tibial nor tarsal brushes present . . . . . *M. differens*
- Sterna of segment 6 in ♂ without processes, those of segment 5 of ♂ with or without processes; tibial and tarsal brushes in ♂ normally present . . . 6
- 6 Colour pattern relatively distinct, usually entire dorsum or axial stripe pale to yellowish, sometimes this stripe divided into two paramedian stripes or broken into series of spots, more or less strongly contrasting with a dark, normally brown background coloration of the sides . . . . . 7
- Colour pattern indistinct, normally dorsum and sides uniformly brown . . . 14
- 7 Sternal process between coxae 4 of ♂ present, conspicuous . . . . . 8
- Sternal process between coxae 4 of ♂ absent to very small . . . . . 10
- 8 Body width < 2.0 mm. Dorsum with axial stripe(s), background coloration brown; gonofemurite not very broad, solenophore evidently longer than 1/2 femurite . . . . . 9
- Body width ≥ 2.0 mm. Dorsum with an axial series of yellowish spots, background coloration dark (red-)brown to black; gonofemurite conspicuously broadened, solenophore scarcely half as long as femurite; Paraguay . . . . . 10
- 9 Dorsum with two yellowish paramedian stripes; tibial and tarsal brushes in ♂ present; a bilobate process present between coxae 4 of ♂; Paraguay . . . . . *M. vittatum*
- Dorsum with two series of paramedian spots; tibial and tarsal brushes in ♂ absent; a lobe-shaped process present between coxae 4 of ♂; Bolivia . . . . . *M. montanum*
- 10 Solenophore with 2-3 prongs/spines subapically . . . . . 11
- End of solenophore subtriangular, often rounded . . . . . 12
- 11 Legs uniformly blackish; a pair of paramedian knobs between coxae 3 of ♂; femora 4-7 in ♂ each with a ventral tubercle, each coxa 7 of ♂ with a distoventral process . . . . . *M. tricuspis*
- Legs brown; a process present between coxae 4 of ♂; apparently neither femora nor coxae of ♂ with ventral tubercles/processes . . *M. pseudomorphum*
- 12 Body width about 3.0 mm. Dorsum with a pale, sometimes yellowish axial stripe; solenophore strongly curved proximad, its end almost in contact with base of femurite . . . . . *M. salvadorii*
- Body width about 2.0 mm. Dorsum with an axial series of conspicuous yellowish spots; solenophore not so strongly curved . . . . . 13
- 13 Median spots situated on proterga and in anterior parts of metaterga; solenophore in medial view almost twice as slender as distofemoral part . . . . . *M. camerani*
- Median spots lying only in middle of metaterga; solenophore in medial view nearly as broad as distofemoral part . . . . . *M. kalliston*
- 14 A single process present between coxae 4 of ♂ . . . . . 15
- Either two cones/tubercles or nothing between coxae 4 in ♂ . . . . . 17
- 15 Body width about 2.0 mm. Sternal process between coxae 4 of ♂ short and subquadrate; solenophore bifid apically . . . . . *M. balzanii*

- Body width 1.3–1.8 mm. Shape of sternal process between coxae 4 in ♂ and of solenophore different ..... 16
- 16 Metatergal sulci distinct on segment 5 and following segments; sternal process between coxae 4 of ♂ short and conical; gonofemorate much broader than solenophore ..... *M. lugubre*
- Metatergal sulci absent; sternal process between coxae 4 of ♂ long and rectangular; gonofemorate considerably slenderer than solenophore *M. borellii*
- 17 Solenophore base conspicuously constricted (Figs 30–32) ..... *M. simplex*
- Solenophore base broader ..... 18
- 18 Body length about 12 mm, width 1.3 mm. Metatergal sulcus visible also on segment 18; pleurosternal carinae present until segment 17; a distoventral tubercle present on femora 4–12 of ♂, and a process on coxae 9 of ♂ (Fig. 38); a characteristic process (**m**) at base of solenophore, tip of solenophore pointed (Figs 39–42) ..... *M. crassipes*
- Body length at least 17 mm, width 1.8 mm. Metatergal sulci either absent or at most traceable only until segment 17; distofemoral tubercles present until leg 10 of ♂ at most; coxae 9 of ♂ normal; no process at base of solenophore, tip of solenophore more or less rounded ..... 19
- 19 Body length 30–34 mm, width 3.8–4.2 mm; tip of solenophore very broadly subtruncate ..... *M. truncatum*
- Body length < 29 mm, width ≤ 3.5 mm; tip of solenomere not subtruncate . 20
- 20 Faint sternal cones traceable between coxae 3 and behind segment 7 of ♂; distoventral tubercles present only on femora 9 and 10 of ♂ . . *M. perfidum*
- Noteworthy sternal modifications absent; distoventral tubercles usually present only until femora 7 of ♂ ..... 21
- 21 Tip of solenophore bilobate, rather deeply emarginate/notched in the middle, forming more or less equal, rounded lobes ..... 22
- Tip of solenophore different ..... 23
- 22 Coloration blackish, legs red-brown; both lobes of solenophore tip subequal; Bolivia ..... *M. derelictum*
- Coloration dark brown, legs light brown; proximal lobe of solenophore tip somewhat smaller than distal one; Paraguay ..... *M. pulvillatum*
- 23 Tip of solenophore subacuminate, narrowly rounded; Bolivia . . . *M. luctuosum*
- Tip of solenophore broadly rounded; Brazil and/or Paraguay ..... 4
- 24 Body coloration dark, legs and venter contrastingly pale; pleurosternal carinae traceable until segment 15; a distoventral tubercle present only on femora 7 of ♂; ventral brushes on tibiae of ♂ absent ..... *M. bicolor*
- Body coloration brown, legs and venter only slightly paler than remaining body; pleurosternal carinae traceable until segment 16; distoventral tubercles present on femora 4–7 of ♂; ventral brushes present both on tibiae and tarsi in ♂ ..... *M. femorale*

#### KEY TO *OLOGONOSOMA* SPECIES

- 1 Sternal process between coxae 4 of ♂ missing; solenomere retrorse; Brazil (Paraná) ..... *O. iguassuense*

- Sternal process between coxae 4 of ♂ represented by two paramedian knobs; solenomere directed distoventrad; Paraguay . . . . . *O. sanctum*

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**On the systematic position of *Podopterocus* Banks and *Dinopsocus* Banks, with a revised diagnosis of the genus *Sigmatoneura* Enderlein (Psocodea: 'Psocoptera': Psocidae)**

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**On the systematic position of *Podopterocus* Banks and *Dinopsocus* Banks, with a revised diagnosis of the genus *Sigmatoneura* Enderlein (Psocodea: 'Psocoptera': Psocidae).** - The genus *Podopterocus* Banks has been known only from male specimens and has been characterized by the thickened first antennal flagellomere and the expanded hind tibia. The genus *Dinopsocus* Banks has been characterized by the thickened first antennal flagellomere. Detailed morphological examinations and brief molecular-based identification (only for one species) suggest that both taxa are congeneric. Based on characters of female terminalia and fore wing venation, both taxa are furthermore considered to be closely related to the genus *Sigmatoneura* Enderlein. The discovery of two new species and observations on *Sigmatoneura* spp. reveal the limited significance of the diagnostic characters of *Podopterocus* and *Dinopsocus*. Therefore we consider both *Podopterocus* and *Dinopsocus* as junior synonyms of *Sigmatoneura*. Monophyly of the genus *Sigmatoneura*, including *Podopterocus*, *Dinopsocus*, and the subgenus *Longifolia* Li, is well supported by the unique fore wing venation of females and by sexually dimorphic fore wing venation and coloration. Two new species, *Sigmatoneura kakisayap* sp. n. and *Sigmatoneura lehmsayap* sp. n., which would be classified under *Podopterocus* or *Dinopsocus* by the previous generic definitions, are described. *Sigmatoneura longicornis* comb. n., the type species of *Podopterocus*, is redescribed and transferred to *Sigmatoneura* and the female of this species is described for the first time. *Dinopsocus atratus*, the type species of *Dinopsocus*, is synonymized with *S. longicornis*. *Sigmatoneura semicolorata* comb. n. is redescribed and transferred from *Dinopsocus* to *Sigmatoneura*.

**Keywords:** Psocodea - Psocidae - *Sigmatoneura* - *Podopterocus* - *Dinopsocus* - systematics - Malaysia - Indonesia - Brunei - Singapore.

## INTRODUCTION

*Podopterus* Banks, 1920 and *Dinopsocus* Banks, 1920 are enigmatic taxa of the family Psocidae. The former genus has been known only from one species, *Podopterus longicornis* Banks, 1920, and only from male specimens (see New, 1975) characterized by highly specialized, broadened hind tibiae (Figs 1D, 3C) and a thickened first antennal flagellomere (Fig. 1D). *Podopterus* was once treated as a subgenus of *Eremopsocus* McLachlan, 1866 by Roesler (1944) but is now regarded as a separate genus (Mockford, 1975) and is assigned to the tribe Cerastipsocini of the subfamily Psocinae (Lienhard & Smithers, 2002). The genus *Dinopsocus* on the other hand contains two species, which are also characterized by a thickened first antennal flagellomere. As *Podopterus*, *Dinopsocus* was once treated as a subgenus of *Eremopsocus* but is now regarded as a separate genus and assigned to the tribe Cerastipsocini (Lienhard & Smithers, 2002). However, a detailed examination of phylogenetically relevant characters of these genera has not yet been carried out. Therefore their exact taxonomic status and systematic position remained unclear. In addition, New (1978) tentatively suggested that *Podopterus* and *Dinopsocus* may represent the same taxon, closely related to the genus *Sigmatoneura* Enderlein, 1908, a member of the tribe Metylophorini (Lienhard & Smithers, 2002).

Recently we obtained some specimens that can be identified as *Podopterus* and/or *Dinopsocus* collected in Brunei, Indonesia (Sumatra), Singapore and Malaysia (peninsula and Sabah). By comparing these specimens and after having examined the type material of *D. atratus*, the type species of the genus *Dinopsocus*, we concluded that these two genera are actually congeneric and show extreme sexual dimorphism. Furthermore, extensive examination of specimens of *Sigmatoneura* revealed that the diagnostic characters for *Podopterus* and *Dinopsocus* are not clear-cut but rather continuous or homoplastic. In the following, we synonymize *Dinopsocus* and *Podopterus* with *Sigmatoneura* and discuss their systematic position based on a morphological examination of this material. We also describe two new species that would be assigned to *Podopterus* and/or *Dinopsocus* in the previous sense, based on specimens from Malaysia and Sumatra.

Methods of morphological examination follow Yoshizawa (2002). Specimens stored in 70% or 99.5% ethanol were used (except for dry preserved *Dinopsocus* types). Depositories of specimens are abbreviated as follow: MCZ - Museum of Comparative Zoology, Harvard University, USA (type specimens of *Dinopsocus*); MHNG - Muséum d'histoire naturelle, Genève, Switzerland; SEHU - Hokkaido University Insect Collection, Sapporo, Japan; UKM - Center for Insect Systematics, Universiti Kebangsaan Malaysia, Bangi, Malaysia.

## SYSTEMATICS

### *Sigmatoneura* Enderlein

*Sigmatoneura* Enderlein, 1908: 761. Type species: *Cerastipsocus subcostalis* Enderlein, 1903.  
*Podopterus* Banks, 1920: 308, **syn. n.**; Mockford, 1975: 251. Type species: *Podopterus longicornis* Banks, 1920. *Eremopsocus* (*Podopterus*): Roesler, 1944: 147.  
*Dinopsocus* Banks, 1920: 307, **syn. n.**; Mockford, 1975: 251. Type species: *Dinopsocus atratus* Banks, 1920. *Eremopsocus* (*Dinopsocus*): Roesler, 1944: 147.



*Revised diagnosis.* Large psocids, fore wing length about 6 mm in male and about 8 mm in female. Antenna very long, first flagellomere normal or sometimes thickened in both sexes (Fig. 1AB vs Fig. 1CDE). Male fore wing hyaline or sometimes with pale pigmentation or blackish brown markings, female fore wing blackish brown (Fig. 2); male fore wing venation normal, female fore wing R4+5 strongly sinuate; Rs and M fused for a short distance, meeting at a point, or connected by a cross vein of variable length in both sexes. Male hind tibia usually weakly flattened and somewhat enlarged, rarely paddle-shaped, on each side with a flat wing-like expansion (Fig. 3); female hind tibia of normal cylindrical shape (Fig. 1BE).

*Sigmatoneura kakisayap* Yoshizawa & Lienhard, sp. n. Figs 1AB, 2AB, 3A, 4, 5

*Podopterocus* sp. Johnson, Yoshizawa & Smith, 2004: 1774.

*Podopterocus* sp. KY240. GenBank (online database for gene sequences): accession number for 18S rDNA of holotype male is AY630557.

*Podopterocus* sp. KY329. GenBank (online database for gene sequences): accession number for 18S rDNA of paratype female is DQ116946.

*Holotype.* Male. MALAYSIA (peninsula), Gunung Berembun, Cameron Highlands, Pahang, 14. vii. 2003, leg. H. Kojima *et al.* (canopy fogging) (UKM).

*Paratypes.* MALAYSIA (peninsula): 2 males, same data as for holotype (SEHU and UKM); 1 male, from the type locality, 15. vii. 2003, leg. H. Kojima *et al.* (canopy fogging) (UKM); 1 female, Gunung Jasar, Cameron Highlands, Pahang, 14. iii. 2003, leg. K. Yoshizawa (beating dead branches) (SEHU); 1 female, from the type locality, 15. vii. 2003, leg. N. Takahashi (sweeping branches) (UKM). MALAYSIA (Sabah - West Coast Residency): 1 male (heavily damaged, lacking antennae and hind legs), Mt. Kinabalu, 1500 m, Liwagu Trail Section 2, 30. iv. 1987, leg D. Burckhardt & I. Löbl (MHNG); 1 female, Mt. Kinabalu, 1750-1850 m, Liwagu Trail, 20. iii. 1983, leg. C. Lienhard (MHNG). INDONESIA (Sumatra): 1 male, Pematang Siantar, 1. vii. 1984 - 13. iv. 1985, leg. E. W. Diehl (MHNG).

*Description.* MALE (Fig. 1A). Head black, with narrow pale markings on frons along internal margins of eyes; gena white. Appendices blackish brown; first flagellomere not thickened. Eye small, IO/D=2.7. Thorax black, except for white membranous regions, propleuron, posterior margin of mesoscutum and metascutellum. Fore wing (Fig. 2A) hyaline, with blackish brown tinge along apical margin between veins R1 and M1, veins and pterostigma black; venation normal, Sc reaching C, Rs-M cross vein long, first section of CuA1 almost perpendicular to the anterior wing margin, CuA1+M connection long. Hind wing hyaline, with brownish tinge posteroproximally, veins black. Legs (Fig. 1A) blackish brown, distal ends of femora and basal ends of tibiae of front and middle legs brown, trochanter and basal end of tibia of hind leg white; hind leg long, hind tibia (Fig. 3A) with symmetrical wing-like expansions along distal 2/3. Abdomen whitish in ground color, dorsally black except for 7th and 8th segments, gray in distal ventral region.

*Terminalia.* Dorsal shelf of clunium absent (Fig. 4AB), dorsal region of clunium with round shallow concavity in the middle. Epiproct (Fig. 4B) without membranous region anteromedially. Paraproct as in Fig. 4AB. Hypandrium (Fig. 4C) covered with wrinkles, anterolaterally fused with clunium, anteromedially with semicircular membranous region, posteriorly with roughly trapezoidal projection and with longitudinal crest medially. Phallosome (Fig. 4D): parameres very weakly sclerotized; aedeagus gradually narrowing to truncated posterior end, posterior margin slightly rounded and

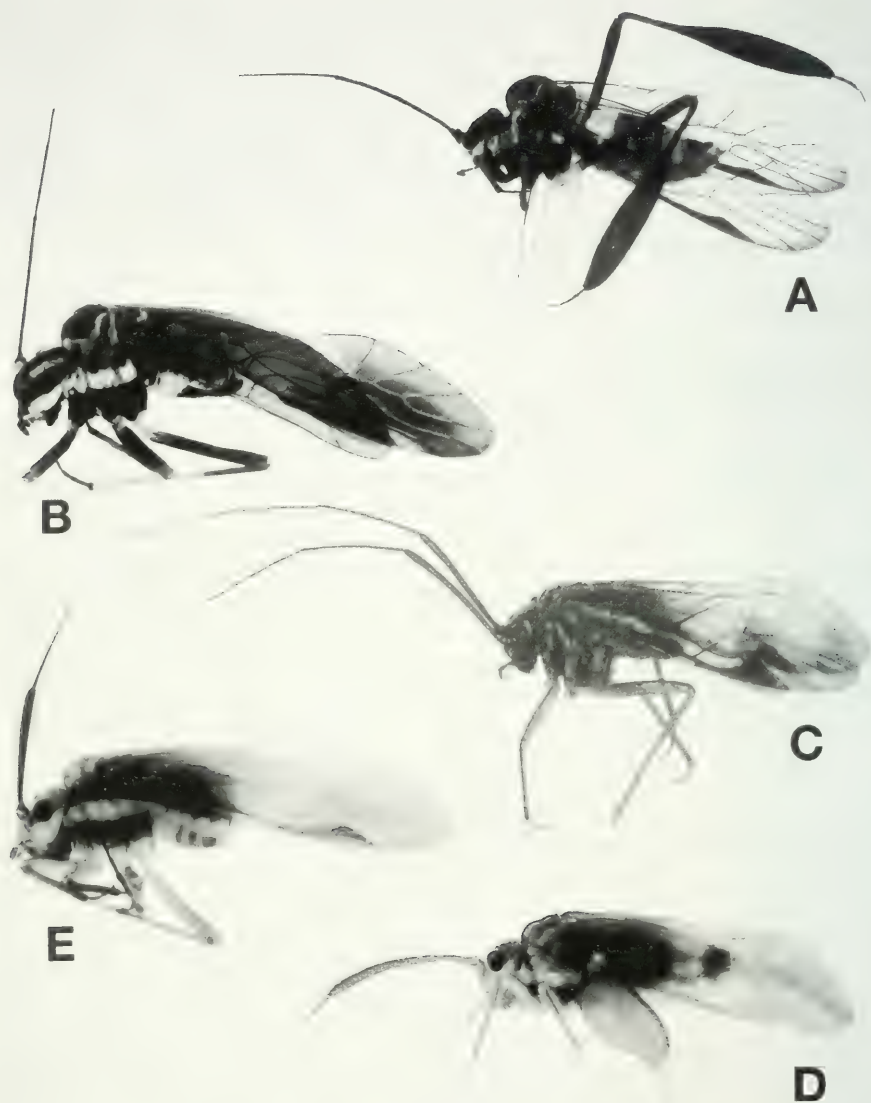


FIG. 1

Habitus of *Sigmatoneura* spp. (C dried specimen, others in alcohol). A: *S. kakisayap* sp. n., male paratype; B: *S. kakisayap* sp. n., female paratype; C: *S. semicolorata*, male holotype; D: *S. longicornis*, male from Brunei; E: *S. longicornis*, female from Singapore.

with tiny denticles laterally; phallobase gradually tapering anteriorly, with very short projection (anteriorly).

Length (in mm): body 4.3-4.5; fore wing 5.8-6.1; hind wing 3.6-3.8.

FEMALE. Almost as in male, except as follows. Head (Fig. 1B): white markings along eyes broad, expanded from antennal sockets to vertex. First and second

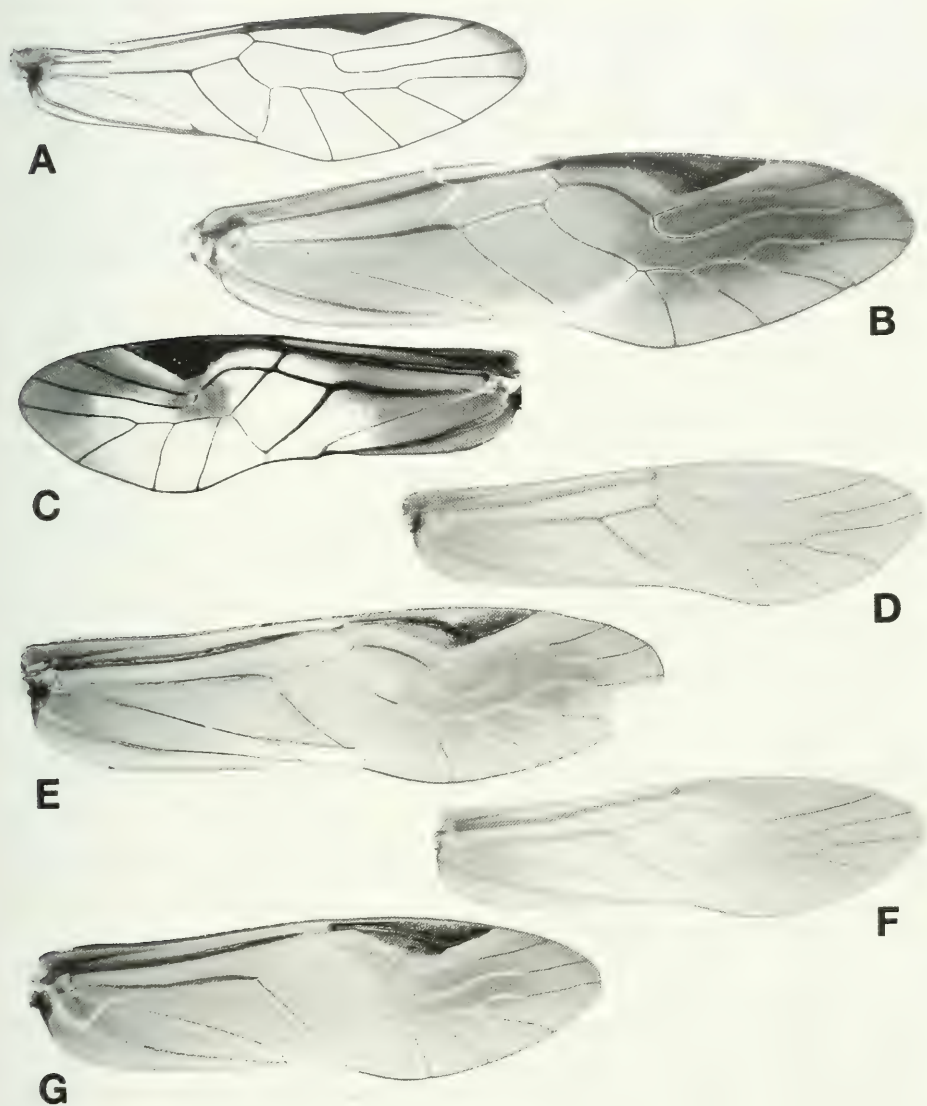


FIG. 2

Fore wings of *Sigmatoneura* spp. A: *S. kakisayap* sp. n., male holotype; B: *S. kakisayap* sp. n., female paratype; C: *S. semicolorata*, male holotype; D: *S. lehmsayap* sp. n., male holotype; E: *S. lehmsayap* sp. n., female paratype; F: *S. longicornis*, male from Brunei; G: *S. longicornis*, female from Singapore.

segments of maxillary palpus white. IO/D=2.9. Thorax: laterally with broad longitudinal white band. Mesoscutellum yellowish white. Fore wing (Fig. 2B) blackish brown, with white region along first section of CuA1 and along posterior wing margin between veins CuA2 and An1; veins and pterostigma black, except the following



yellowish white veins: basal section of Rs, basal 2/3 of R2+3, basal 3/4 of R4+5, Rs-M cross vein, M, basal parts of M branches, and CuA; R4+5 strongly sinuate in the middle, Rs-M cross vein long, first section of CuA1 directed anterodistally, CuA1+M connection short. Hind wing pale brown, its veins black. Legs (Fig. 1B): hind leg normal, hind tibia white in distal 2/3.

**Genitalia.** Subgenital plate (Fig. 5A): egg guide pointed apically, with transversal crest basally; body of subgenital plate wide, connected with egg guide by narrow sclerite, anteromedian part broadly membranous. Gonapophyses (Fig. 5B): ventral valve long; dorsal valve widely membranous, without distal process; external valve short and wide, densely covered with long setae along posterior margin.

Length (in mm): body 4.6-5.1; fore wing 7.9-8.4; hind wing 5.2-5.3.

**Distribution.** Malaysia (peninsula and Sabah), Indonesia (Sumatra).

**Etymology.** The specific epithet, a noun in apposition, is a combination of two Malayan words, kaki (= leg) and sayap (= wing). The synonymized generic name *Podopterus* is a combination of the Greek words for «leg» and «wing».

**Remarks.** This new species can be distinguished from the other species of the genus *Sigmatoneura* by the long hind tibia with dorso-ventrally symmetrical wing-like expansions in the male (Fig. 3A, cf. 3BC) and by the morphology of the subgenital plate in the female.

Males and females of this species (Fig. 1AB) are significantly different in fore wing coloration and venation, and in hind leg morphology. Therefore male-female conspecificity was also checked by analysing a 957 bp fragment of the 18S rDNA gene sequence (GenBank accession numbers: AY630557 for holotype male and DQ116946 for one female paratype from Gunung Jasar). No substitution has been identified between the gene sequences of the male holotype and the female paratype, which supports conspecificity.

***Sigmatoneura semicolorata* (Banks) comb. n.**

Figs 1C, 2C, 6

*Dinopsocus semicoloratus* Banks, 1920: 307.

*Eremopsocus (Dinopsocus) semicoloratus*: Smithers, 1967: 98.

**Specimen examined.** Holotype male. PHILIPPINES, Luzon, Makiling, leg. C. F. Baker (MCZ: 10801).

**Redescription** (coloration in dried condition). MALE (Fig. 1C). Head blackish brown. Appendices blackish brown; first flagellomere thickened. Eye small, IO/D=2.4. Thorax blackish brown. Fore wing (Fig. 2C) hyaline, basal 1/3 and apical part blackish brown, anterior part of apical marking extending proximally to apical part of Rs and CuA1+M connection, veins and pterostigma black; venation normal, Sc reaching C, Rs and M fused for a short distance, first section of CuA1 directed anterodistally, CuA1+M connection short. Hind wing hyaline, basal 1/3 brown, veins black. Legs (Fig. 1C) blackish brown; hind tibia almost normal, very slightly flattened apically. Abdomen blackish brown, with whitish longitudinal band laterally.

**Terminalia.** Dorsal shelf of clunium absent (Fig. 6AB). Epiproct (Fig. 6B) with narrow membranous region anteromedially, and with slight transversal swelling medially. Paraproct as in Fig. 6AB. Hypandrium (Fig. 6C) with smooth surface posteriorly, lateral region with some weak wrinkles, anterolaterally fused with clunium,

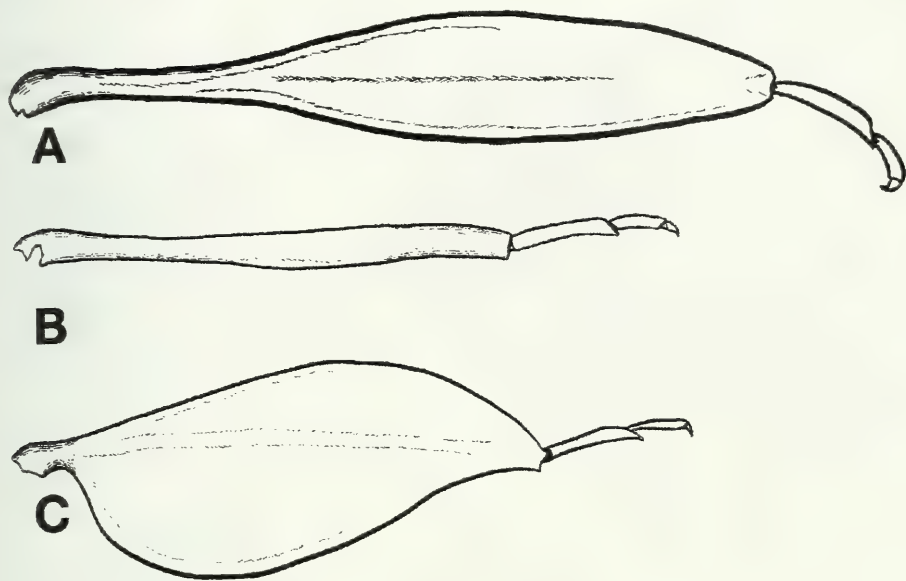


FIG. 3

Male hind tibiae of *Sigmatoneura* spp. A: *S. kakisayap* sp. n., male holotype; B: *S. lehmsayap* sp. n., male holotype; C: *S. longicornis*, male from Brunei.

anteromedially with triangular membranous region, posteriorly with roughly trapezoidal projection. Phallosome (Fig. 6D) relatively long, opened basally; parameres rather well sclerotized; aedeagus gradually narrowing to truncated posterior end, posterior margin slightly concave and with tiny denticles posterolaterally; phallobase tapering anteriorly, without projection.

Length (in mm): body 3.8; fore wing 5.9; hind wing 4.1.

*Distribution.* Philippines (Luzon).

*Remarks.* *S. semicolorata* can be distinguished from the other species of the genus *Sigmatoneura* by the unique male fore wing markings. *S. kakisayap* sp. n., described above, has also hyaline fore wings with some dark brown markings, but it differs from *S. semicolorata* by the absence of a thickened first flagellomere and by the greatly expanded hind tibia. The presence of a thickened first flagellomere in *S. semicolorata* indicates some relationships with the two species described below, but coloration of fore wing in male is remarkably different. The female of *S. semicolorata* is so far unknown.

***Sigmatoneura lehmsayap* Yoshizawa & Lienhard, sp. n.**

Figs 2DE, 3B, 7, 8A

(?) *Dinopsocus atratus* Banks sensu New, 1978: 45 (see remarks below).

Not *Dinopsocus atratus* Banks, 1920: 307 (see *S. longicornis*, below).

*Holotype.* Male. INDONESIA (N-Sumatra), «Holzweg 2», 10 km NE Prapat, 1050 m, 98°57' E, 2°44' N, 9. i. 1988, leg. E. W. Diehl (MHNG).

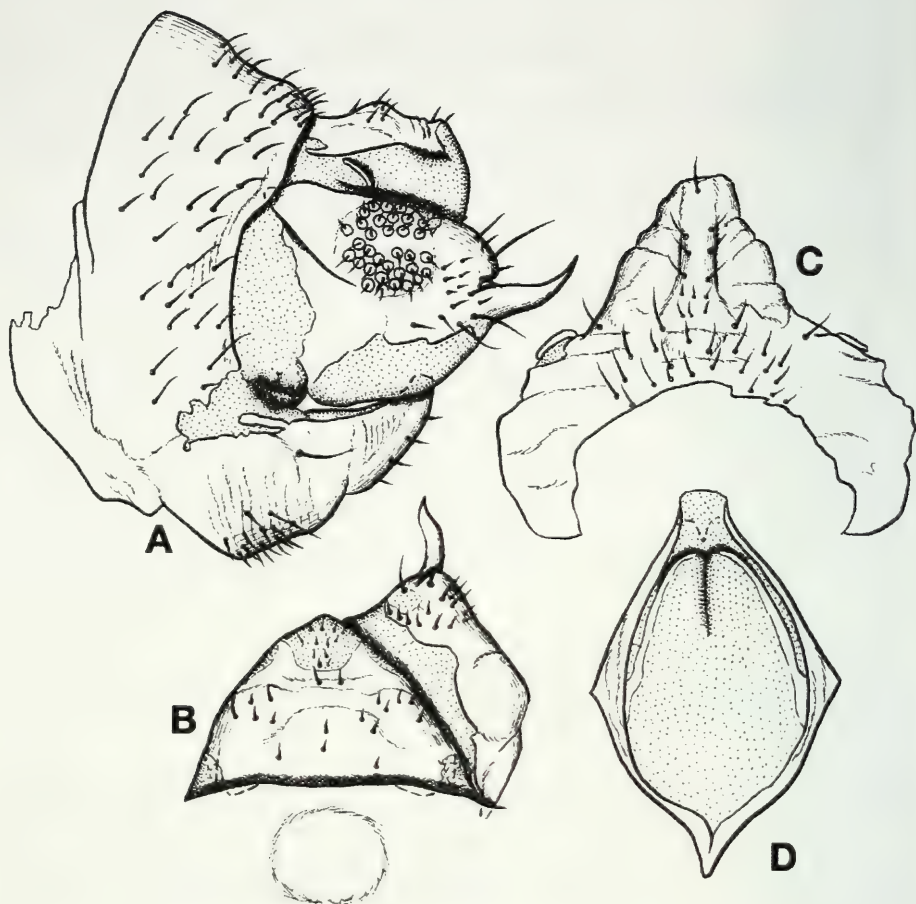


FIG. 4

Male terminalia (holotype) of *Sigmatoneura kakisayap* sp. n. A: terminalia, lateral view; B: epi-proct and left paraproct (trichobothrial field not figured), dorsal view; C: hypandrium, ventral view; D: phallosome, ventral view.

*Paratypes*. INDONESIA (N-Sumatra): 1 female, same locality as for holotype, 27. xi. 1989, leg. E. W. Diehl (MHNG); 1 female, Huta Padang, 99°14' E, 2°45' N, 400 m, 2. ii. 1991, leg. H. Malicky (MHNG).

*Description*. MALE. (Male holotype in bad condition, coloration of body, except for wings, almost indistinguishable: i.e., just uniformly pale brown without any distinct marking). First flagellomere thickened. Eye small, IO/D=2.6. Fore wing (Fig. 2D) pale brown, veins black; venation normal, Sc ending in cell c, Rs-M cross vein short, first section of CuA1 directed anterodistally, CuA1+M connection short. Hind wing pale brown, basal 1/3 darker, veins brown. Hind tibia (Fig. 3B) with very weakly developed asymmetrical expansions along distal half, ventral expansion stronger (confirmed for both hind legs).



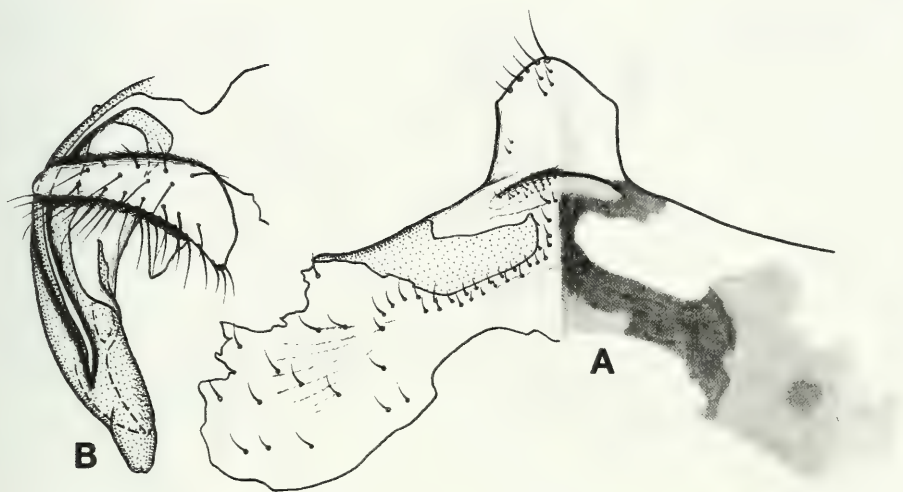


FIG. 5

Female genitalia (paratype) of *Sigmatoneura kakisayap* sp. n. A: subgenital plate, showing structure (left) and color pattern (right); B: gonapophyses.

Terminalia. Dorsal shelf of clunium absent (Fig. 7A), dorsal region of clunium with round shallow concavity in the middle. Epiproct (Fig. 7A) with membranous region anteromedially. Paraproct as in Fig. 7A. Hypandrium (Fig. 7B) with smooth surface, only laterally with few wrinkles, anterolaterally fused with clunium, anteromedially with broad membranous region, posteriorly with semicircular projection. Phallosome (Fig. 7C): parameres very weakly sclerotized; aedeagus gradually narrowing to truncated posterior end, posterior margin slightly rounded and with tiny denticles; phallobase gradually tapering anteriorly, with short projection (anteriorly).

Length (in mm): body 4.6; fore wing 6.2; hind wing 4.3.

FEMALE. Head brown; gena white. Appendices brown; first and second segments of maxillary palpus paler. First flagellomere thickened. Eye black, IO/D=3.0. Thorax brown, laterally with broad longitudinal white band; meso- and metascutellum paler. Fore wing (Fig. 2E) brown, with white region along first section of CuA1 and along posterior wing margin between veins CuA2 and An1; veins and pterostigma black, except the following yellowish white veins: basal section of Rs, basal 2/3 of R2+3, basal 3/4 of R4+5, Rs-M cross vein, M, basal parts of M branches, and CuA; R4+5 strongly sinuate in the middle, Rs-M cross vein long, first section of CuA1 directed anterodistally, CuA1+M connection short. Hind wing pale brown, with darker portion anteroproximally; veins black. Legs brown; trochanters and base of femora paler; hind leg of normal cylindrical shape.

Genitalia. Subgenital plate (Fig. 8A): egg guide with a pair of very shallow trenches anterolaterally, truncated apically, apical margin folded upwards and some apical setae arising from dorsal surface of egg guide; body of subgenital plate wide, connected with egg guide by narrow sclerite, anteromedian part broadly membranous. Gonapophyses as in *S. kakisayap* sp. n. (see description above).

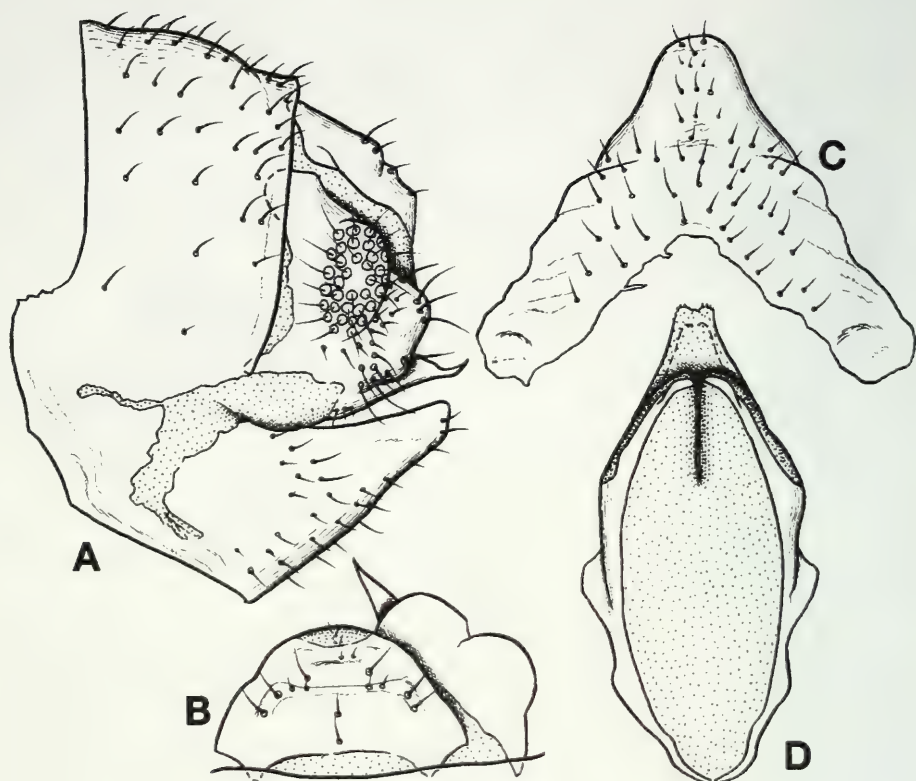


FIG. 6

Male terminalia (holotype) of *Sigmatoneura semicolorata*. A: terminalia, lateral view; B: epi-proct and left paraproct (trichobothrial field not figured), dorsal view; C: hypandrium, ventral view; D: phallosome, ventral view.

Length (in mm): body 4.2-5.0; fore wing 7.2-7.6; hind wing 5.2-5.3.

*Distribution.* Indonesia (Sumatra).

*Etymology.* The specific epithet, a noun in apposition, is a combination of two Indonesian words, lemah (= weak) and sayap (= wing). The synonymized genus *Podopteroecus* was characterized by the wing-like hind tibia of males, but in this species the hind tibia is only weakly expanded in males.

*Remarks.* *S. lemahsayap* sp. n. is most similar to *S. longicornis*, redescribed below, because of the thickened first flagellomere in both sexes and the widely pigmented fore wing in males. However, these species can be clearly distinguished by the shape of the male hind tibia. In having a less expanded hind tibia, *S. lemahsayap* is similar to most *Sigmatoneura* species, but it differs from them by its thickened first flagellomere.

The female from Kuala Lumpur described by New (1978) as *Dinopsocus atratus* shows an egg guide which is strikingly similar to that of *S. lemahsayap* (cf. Fig. 8A

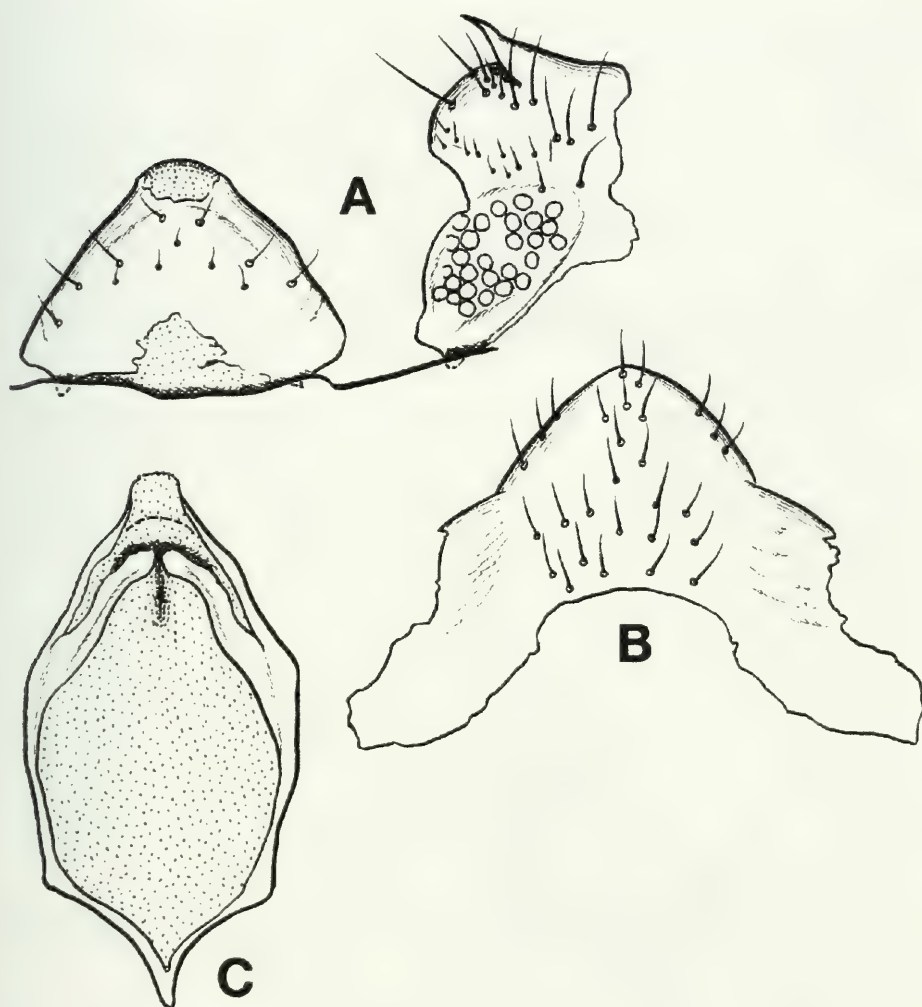


FIG. 7

Male terminalia (holotype) of *Sigmatoneura lemahsayap* sp. n. A: epiproct and left paraproct; B: hypandrium, ventral view; C: phallosome, ventral view.

and New, 1978: fig. 6). Therefore we consider it as very probable that New's specimen does not belong to *S. longicornis* (= *D. atratus*, see below) but to *S. lemahsayap*. The specimen from Kuala Lumpur should be re-examined to check this hypothesis.

*Sigmatoneura longicornis* (Banks) comb. n.

Figs 1DE, 2FG, 3C, 8B, 9

*Podopterus longicornis* Banks, 1920: 308.

*Eremopsocus* (*Podopterus*) *longicornis*: Roesler, 1944: 147; New, 1975: 245 (redescription of male, see remarks below).



*Dinopsocus atratus* Banks, 1920: 307, **syn. n.**

(?) Not *Dinopsocus atratus* Banks sensu New, 1978: 45 (see remarks on *S. lehmsayap*, above). *Eremopsocus* (*Dinopsocus*) *atratus*: Roesler, 1944: 147.

*Specimens examined.* Lectotype female of *Dinopsocus atratus* (present designation), [MALAYSIA (Sabah):] Borneo, Sandakan, leg. C. F. Baker (MCZ: 10800); paralectotype female of *D. atratus* (present designation), PHILIPPINES [Luzon], Mt. Banahao, leg. C. F. Baker (MCZ: 10800); non-type female of *D. atratus* mentioned in the original description, SINGAPORE, leg. C. F. Baker (MCZ).

BRUNEI: 1 male (reared from nymph) and 4 nymphs, Bru-88/30 (Belait District), Sungai Liang, Arboretum of Forest Service, primary forest (mixed dipterocarp forest), alt. about 50m, 21. xi. 1988, leg. C. Lienhard (MHNG); 1 male, Bru-88/42, same locality and collector, alt. 20-50 m, 25. xi. 1988 (SEHU). MALAYSIA (Sabah): 1 female, Sepilok, 24 km W of Sandakan, v-viii, 1983, leg. S. Nagai (MHNG). SINGAPORE: 1 female, Bukit Timah Nature Reserve, 16. xi. 1981, leg. D. H. Murphy (MHNG); 1 female, same locality, no date, leg. D. H. Murphy (MHNG).

*Diagnosis.* The male of this species is easily distinguishable from any other psocid by the unique structure of its hind tibia, which is distinctly paddle-shaped due to a conspicuous, flattened, wing-like expansion on each side; these expansions are dorso-ventrally asymmetrical, the ventral expansion is broadest at basal 1/3 and the dorsal expansion broadest at distal 1/3 (Fig. 3C). The female of this species is very similar to that of *S. lehmsayap* sp. n., described above, but can be distinguished by the shape of egg guide (Fig. 8B).

Length of male (Bru-88/42, in mm): body 4.5; fore wing 5.8; hind wing 4.1.

*Redescription of male terminalia.* Clunial dorsal shelf absent (Fig. 9AB). Epiproct (Fig. 9B) with membranous region anteromedially. Paraproct as in Fig. 9AB. Hypandrium (Fig. 9C) with smooth surface, only mediolaterally with few wrinkles; anterolaterally fused with clunium; anteromedially with broad membranous region; posteriorly with semicircular projection. Phallosome (Fig. 9D): parameres very weakly sclerotized; aedeagus narrowing to truncated posterior end, posterior margin slightly concave; phallobase gradually tapering anteriorly, with very short projection (anteriorly).

*Description of female.* Very similar to the previous species, *S. lehmsayap* sp. n., but smaller. Apical margin of egg guide of subgenital plate truncated in *S. lehmsayap* but arched in *S. longicornis* (Fig. 8AB).

Length (in mm): body 4.5-4.8; fore wing 6.6-6.7; hind wing 4.6-4.8.

*Distribution.* Singapore (Banks, 1920; New, 1975; present study), Malaysia (Sabah [Banks, 1920 and present study]; peninsula [Banks, 1938]), Brunei (present study), Philippines (Banks, 1920). NOTE: Soehardjan (1958) lists *Dinopsocus atratus* for Sarawak, probably because of an erroneous interpretation of Banks' original statement («Borneo: Sandakan»), and Endang *et al.* (2002) erroneously list it for Indonesia.

*Remarks.* *S. longicornis*, the type species of *Podopteroecus*, has been described from a male collected in Singapore (sex not mentioned in the original description, but the holotype of *Podopteroecus longicornis* must be a male because of having a broadly expanded hind tibia). Banks' description and figures (Banks, 1920: pl. 1, fig. 4, fore wing and hind tibia) closely correspond to our specimens from Brunei, and we are convinced that they belong to the same species. *S. longicornis* has briefly been redescribed by New (1975) on the basis of three males from Singapore. The only significant difference between New's description and our observations on the Brunei males

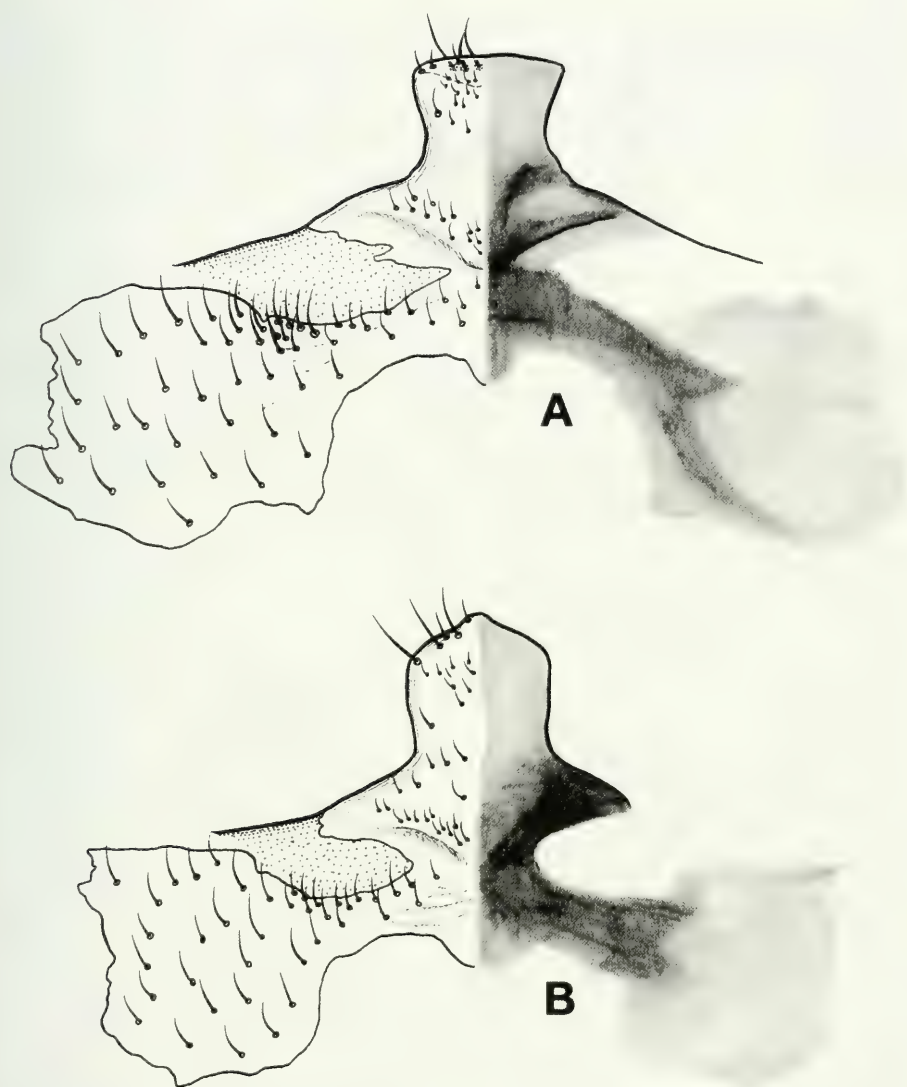


FIG. 8

Female subgenital plates. A: *Sigmatoneura lemahsayap* sp. n. (paratype); B: *Sigmatoneura longicornis* (specimen from Singapore).

concerns the «broad rugose apex» of the phallosome mentioned by New, which contrasts with the slightly concave, smooth apical margin of the phallosome in the Brunei material. The differences concerning the shape of the expanded hind tibia and of the phallobase between our Figs 3C and 9D and New's figures 8 and 11, are probably due to deformations by slide-mounting (phallosome) and to some teratological phenomena or optical distortion (hind leg). In our opinion, it is not very likely that

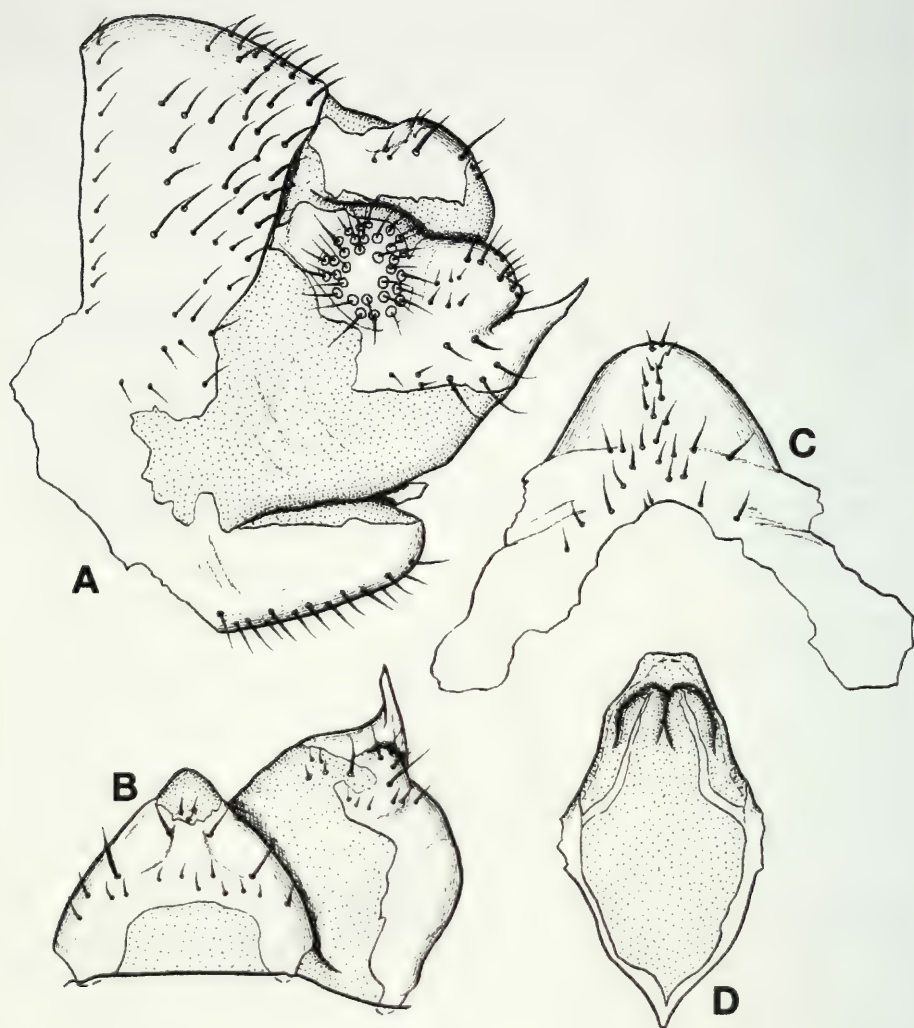


FIG. 9

Male terminalia of *Sigmatoneura longicornis* (specimen from Brunei). A: terminalia, lateral view; B: epiproct and left paraproct (trichobothrial field not figured), dorsal view; C: hypandrium, ventral view; D: phallosome, ventral view.

New's specimens belong to an additional species closely related to *S. longicornis*. However, this possibility can only be excluded with certainty after a re-examination of New's material. Concerning shape of hind tibia, our Brunei males correspond more closely to Banks' than to New's figure. In our opinion this justifies the assumption that these specimens are conspecific with the male holotype of *S. longicornis*.

Male and female specimens of the present material assigned to *S. longicornis* are superficially highly divergent and have not been collected simultaneously. There-



fore the proposed male-female combination remains somewhat tentative. However, three females examined above were collected in Singapore, type locality of *S. longicornis*. Their morphological features do not contradict the present observations concerning sexual dimorphism in the genus *Sigmatoneura* (see Discussion, below). The only other *Sigmatoneura* species with a thickened first flagellomere, from which female genital morphology has been described, is *S. lehmsayap* sp. n., which is distinguished by the shape of its egg guide (Fig. 8AB).

## DISCUSSION

In the present study we examined some psocid species that have been or that can be assigned to the genera *Podopterocus* and/or *Dinopsocus* which are here placed in the synonymy of *Sigmatoneura*. Although a greatly expanded hind tibia has been recognized as the most prominent diagnostic character of *Podopterocus*, our present examination revealed that in some species the hind tibia is sexually dimorphic in shape. Since *Podopterocus* has been diagnosed by such a dimorphic character, the genus has been known only from males. The genus *Dinopsocus* on the other hand has been characterized by the thickened first flagellomere, but this character is also present in males and females of *Podopterocus longicornis*, the type species of *Podopterocus* (Fig. 1DE). Furthermore, the lectotype of *Dinopsocus atratus* (type species of *Dinopsocus*) is considered to be a female of *P. longicornis*. As already suggested by New (1978), it is now evident that females of *Podopterocus* have been assigned to the genus *Dinopsocus* because of this extreme sexual dimorphism. Male-female combination of these highly sexually dimorphic psocids was confirmed genetically only for *Sigmatoneura kakisayap* sp. n., described and discussed above, the female of which is not of «*Dinopsocus* type» (i.e., lacking a thickened first flagellomere). However, the result of the molecular male-female match clearly indicates that the expanded hind tibia is a secondary sexual character only developed in males, while corresponding females have a normal cylindrical hind tibia. Similar sexual dimorphism is also known in some psocids of the family Caeciliusidae. For example, in the *flavidus* group of the genus *Valenzuela* Navas (see Mockford, 1993; Lienhard, 1998) and in the genus *Phymocaecilius* Li (see Li Fasheng, 2002) a more or less conspicuous swelling of the fore tibia (and sometimes middle tibia) has been observed in males, never in females. Based on these observations, we concluded that the species described under *Podopterocus* and *Dinopsocus* are actually congeners. The above mentioned molecular-based match of a «*Podopterocus* type» male with a «*Sigmatoneura* type» female definitively confirmed close relationships between these taxa, as already suggested by New (1978). In the following we discuss the arguments in favor of synonymizing *Podopterocus*, *Dinopsocus* and *Sigmatoneura* instead of assigning subgeneric status to *Podopterocus/Dinopsocus* within the genus *Sigmatoneura* s. l.

Mosaic distribution of the diagnostic characters of *Podopterocus* and *Dinopsocus* is evident. *S. longicornis*, *S. lehmsayap* sp. n. and *S. semicolorata* belong to the «*Dinopsocus* type» in having a thickened first flagellomere in both sexes. In contrast, *S. longicornis* and *S. kakisayap* are clearly of the «*Podopterocus* type» in having a greatly expanded paddle-shaped hind tibia in males. *S. lehmsayap* has a slightly but distinctly expanded hind tibia and therefore is close to «*Podopterocus*

type». Checking our material of *Sigmatoneura* s. str. (i. e., species without thickened first flagellomere and without significant expansion of male hind tibia: e. g., *S. kolbei*), we observed a general tendency for very slight expansion and flattening of the hind tibia in males.

The apomorphic presence of a long Rs-M cross vein in the fore wing was observed in all possible *Podopteroecus* and/or *Dinopsocus* species (except for *S. semicolorata*). However, an Rs-M cross vein was also observed in some *Sigmatoneura* s. str. species, showing a certain variability from almost fused at one point to as long as in *S. kakisayap*. All known species of the subgenus *Sigmatoneura* (*Longifolia*) Li, 2002 also have a long Rs-M cross vein (Li Fasheng, 2002). Therefore, this character state also cannot be used to diagnose *Podopteroecus* and/or *Dinopsocus*.

The thickened first flagellomere is shared by three of four species examined above (*S. longicornis*, *S. lehmsayap* and *S. semicolorata*), but a secondary reversal of the character state in *S. kakisayap* is also possible (see also discussion below). New (1978) mentioned that the subcosta of *Dinopsocus* is long and approaching R, whereas that of *Sigmatoneura* is short and approaching the costa, and he tentatively considered this character as diagnostic for these genera. However, in all specimens examined here, the subcosta is short and approaching the costa (Fig. 2). No other apomorphic characters clearly characterizing *Podopteroecus* and/or *Dinopsocus* could be found. Judging from these observations, we concluded that the differences between *Sigmatoneura* s. str. and *Podopteroecus*/*Dinopsocus* are continuous or highly homoplastic and that it is impossible to clearly define the latter genera. Thus, synonymizing these genera with *Sigmatoneura* is the most reasonable and practical solution. Monophyly of *Sigmatoneura*, including *Podopteroecus*, *Dinopsocus* and the subgenus *Longifolia*, is well supported by the following unique autapomorphies: female fore wing blackish brown in ground color, with veins R2+3, R4+5 and first section of CuA1 white, and with vein R4+5 strongly sinuate; sexual dimorphism in fore wing coloration and venation. Molecular data (18S rDNA: Johnson *et al.*, 2004) also show that *Sigmatoneura*, including *Podopteroecus*/*Dinopsocus* (at least *S. kakisayap*), form a monophyletic group.

Among the species examined above, *S. longicornis*, *S. lehmsayap* and *S. semicolorata* share an apomorphic character state, the thickened first flagellomere, whereas *S. kakisayap* has normal antennae in both sexes. In contrast, *S. longicornis* and *S. kakisayap* share an apomorphic condition, the well expanded hind tibia, whereas in *S. lehmsayap* and *S. semicolorata* the male hind tibia is only slightly expanded. As already mentioned above, there are conflicts in the distribution of apomorphic character states among these species. Well expanded paddle-shaped hind tibia in males might have evolved independently in *S. longicornis* and *S. kakisayap*, because the expansion in *S. kakisayap* is symmetrical, whereas that in *S. longicornis* and *S. lehmsayap* is clearly asymmetrical, although weakly developed in the latter species.

The subgenus *Longifolia* was recognized in the genus *Sigmatoneura* by Li Fasheng (2002). This subgenus shares the characteristic sexual dimorphism in the fore wing coloration and venation with the subgenus *Sigmatoneura*. *Longifolia* is characterized by the elongate egg guide of the female subgenital plate (autapomorphic for the subgenus) and thus monophyly of the subgenus can be confirmed. However, no

apomorphy supporting the monophyly of the subgenus *Sigmatoneura* is known. Although we do not propose here synonymy of *Sigmatoneura* and *Longifolia*, we would like to point out the fact that Li's treatment probably established a paraphyletic taxon (the subgenus *Sigmatoneura*).

*Podopterocus* and *Dinopsocus* have previously been assigned to the tribe Cerastipsocini, whereas *Sigmatoneura* has been classified under the tribe Metylophorini sensu Mockford (1993) (Smithers, 1980; Lienhard & Smithers, 2002). Placement of *Sigmatoneura* into Metylophorini is based on the shape of the gonapophyses, i. e., absence of the distal process of the dorsal valve, which is considered to be an autapomorphy for the tribe. Females of possible *Podopterocus* and *Dinopsocus* examined here also have this character state (Fig. 5B); therefore placement of *Sigmatoneura*, including *Podopterocus* and *Dinopsocus*, into Metylophorini is justified. Li Fasheng (2002) established the subfamily Sigmatoneurinae for the genus *Sigmatoneura*, and assigned the tribes Cerastipsocini and Metylophorini (sensu Mockford, 1993) to a different subfamily (Cerastipsocinae). As mentioned above, the genus *Sigmatoneura* shares an apomorphic character with the other genera of Metylophorini, and Li's subdivision of the family Psocidae has to be rejected.

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## Review of the species of *Platypalpus* Macquart from Guangxi, China (Diptera, Hybotidae, Tachydromiinae)

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**Review of the species of *Platypalpus* Macquart from Guangxi, China (Diptera, Hybotidae, Tachydromiinae).** - The species of the genus *Platypalpus* Macquart from Guangxi (Southern China) are reviewed. The following 3 species are described, illustrated and discussed: *P. alamaculatus* sp. n., *P. maoershanensis* sp. n., *P. xanthodes* sp. n. A key to the species of *Platypalpus* from Guangxi is presented.

**Keywords:** Hybotidae - Tachydromiinae - *Platypalpus* - Guangxi - new species.

## INTRODUCTION

*Platypalpus* Macquart is one of the largest genera of the subfamily Tachydromiinae (Hybotidae). It can be easily recognized by the following characters: eyes narrowly separated on face, mid leg raptorial, and anal cell present (Chvála, 1975; Grootaert & Chvála, 1992). The genus has a worldwide distribution and its center of diversity seems to be the Western Palaearctic region with some 250 described species (Chvála & Kovalev, 1989; Grootaert & Chvála, 1992). In contrast, only some 31 species were described from the Oriental region up to 1975 (Smith, 1975). Since then, 25 species from China have been added by Yang, D. & Yang, C. (1989, 1990, 1992, 1997), Yang, C. & Yang, D. (1992), Saigusa & Yang (2002), Yang *et al.* (2002). Therefore, 33 species of *Platypalpus* have been reported from China. The major references dealing with *Platypalpus* are as follows: Brunetti, 1920; Frey, 1943; Smith, 1965; Chvála, 1975, 1989; Grootaert, 1984; Grootaert & Chvála, 1992.

The genus *Platypalpus* from Guangxi (Southern China) is poorly studied with only *Platypalpus guangxiensis* Yang & Yang, 1992 known from this province. In the present paper, three species are described as new to science, based on the specimens collected by Ms Shuwen An and Mr Xingyue Liu by sweep net and light trap in 2003. A key to all four species from Guangxi is presented.

## MATERIAL AND METHODS

The specimens on which this study is based on are deposited in the following collections:

CAU = Insect collection of China Agricultural University, Beijing, China

MHNG = Muséum d'histoire naturelle, Genève, Switzerland

In order to allow an easy comparison of descriptions of various authors, the terminology of morphological terms follows generally Grootaert & Chvála (1992), except for crossveins which are written in capitals.

The following abbreviations for bristles are used: acr-acrostichial, ad-antero-dorsal, av-anteroventral, dc-dorsocentral, h-humeral, oc-ocellar, npl-notopleural, pd-posterodorsal, psa-postalar, pv-posteroventral, sa-supraalar, sc-scutellar, vt-vertical.

## KEY TO THE SPECIES OF *PLATYPALPUS* FROM GUANGXI

- 1 Thorax mainly yellow; wing without dark spots; mid femur entirely yellow . . 2
- Thorax black; wing with brown spot between Costa and R-M (Fig. 1);  
mid femur black with yellow tip . . . . . *alamaculatus* sp. n.
- 2 Mesonotum entirely yellow . . . . . 3
- Mesonotum yellow with rather large black mid-longitudinal spot  
. . . . . *maoershanensis* sp. n.
- 3 Scutellum yellow; apical projection of right genital lamella with wide  
obtuse apex (Fig. 11) . . . . . *xanthodes* sp. n.
- Scutellum black; apical projection of right genital lamella with acute  
apex . . . . . *guangxiensis* Yang, C. & Yang, D., 1992

## SPECIES TREATMENT

### 1. *Platypalpus alamaculatus* sp. n.

Figs 1-5

#### MATERIAL

Holotype ♂, CHINA: Guangxi: Maoershan National Nature Reserve, 1100-1600 m, 29.VI.2003, Xingyue Liu (CAU).

Paratypes: 5♂♂, 7♀♀, same data as holotype (CAU); 5♂♂, 10♀♀, Guangxi: Maoershan National Nature Reserve, Hongjunting, 1600 m, light trap, 28.VI.2003, Xingyue Liu (CAU); 3♂♂, 3♀♀, Guangxi: Maoershan National Nature Reserve, Sanjiangyuan, 1900 m, light trap, 30.VI.2003, Xingyue Liu (MHNG); 4♂♂, 1♀, Guangxi: Maoershan National Nature Reserve, Sanjiangyuan, 1900 m, light trap, 30.VI.2003, Shuwen An (CAU).

#### ETYMOLOGY

The specific name refers to the maculate wing.

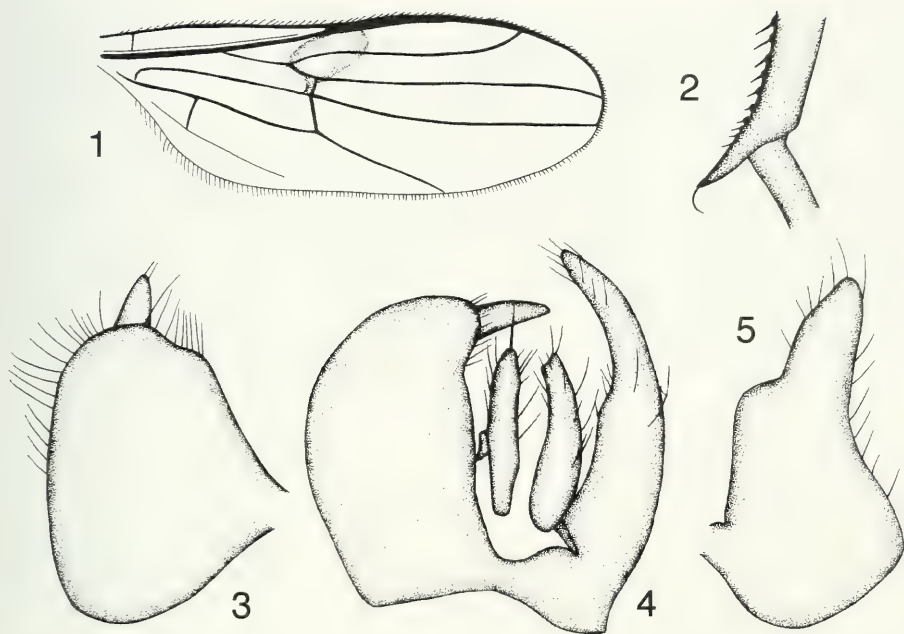
#### DIAGNOSIS

Mainly black species; head with 2 vt; wing with a brown spot between C and R-M (Fig. 1); legs yellow, but mid and hind coxae black; mid femur black with yellow tip; mid femur with row of pv bristles; mid tibia with long acute apical spur bearing 1 curved apical hair (Fig. 2).

#### DESCRIPTION

*Male.* Body length 2.6-2.8 mm, wing length 2.9-3.1 mm.





FIGS 1-5

*Platypalpus alamaculatus* sp. n, male. 1, wing; 2, apex of mid tibia; 3, right genital lamella; 4, genitalia, dorsal view; 5, left genital lamella.

Head, including occiput and clypeus black, gray microtrichose. Eyes narrowly separated on face; frons wider than face. Jowls in lateral view very narrow, almost invisible. Hairs on head pale, bristles black. Ocellar tubercle with 1 oc and 2 posterior hairs; 2 vt (curved inward vt short). Antenna black; pedicel with a circle of apical hairs; first flagellomere short conical, about 1.3 times longer than wide, with some short pale apical hairs; arista 4.5-4.7 times as long as first flagellomere, black, short pubescent. Proboscis blackish with blackish bristles; palpus brown to blackish with 3 long pale bristles (apical bristle long).

Thorax black, grey microtrichose. Hairs on thorax pale, bristles blackish; 1 short weak h curved medially, 2 npl (anterior npl short), acr in about 4 irregular rows, 1 short psa, long dc and presc absent, scutellum with 2 pairs of sc, basal sc one third as long as apical sc. Legs yellow; fore coxa yellow, mid coxa and posterior half of hind coxa black; mid trochanter black; fore and hind femora yellow, mid femur black with yellow tip; tarsomeres 3-5 of all legs gradually becoming darker towards tip. Hairs on legs blackish, bristles black. Coxae with pale bristles and hairs. Fore femur 1.3 times and mid femur 2.0 times as wide as hind femur; fore femur with one row of short av and one row of long pv (4 apical av the longest); mid femur with two rows of very short black v spine-like bristles (but ventral bristles on basal quarter longer), and with one row of rather long brownish yellow pv; fore tibia with 3 ad, apically with 1 ad; mid tibia (Fig. 2) with a row of short weak black ventral bristles and long acute apical spur

(distinctly longer than thickness of mid tibia) bearing 1 curved apical hair. Wing (Fig. 1) hyaline with a brown spot from tip of cell c running to R-M; veins dark brown,  $R_{4+5}$  and M slightly convergent apically; crossveins almost contiguous. Squama yellow with brownish margin, with pale hairs. Halter yellow with brownish yellow base.

Abdomen subshining black, very thinly grey microtrichose. Hairs on abdomen pale. Male genitalia (Figs 3-5): Left genital lamella rather narrow in dorsal view, its apical projection finger-like; right genital lamella rather wide in dorsal view, its apical projection rather small and subtriangular; both cerci equally long, right cercus slightly narrower.

*Female*. Body length 2.3-2.5 mm, wing length 2.8-3.0 mm. Similar to male, but av and pv on fore femur shorter except 3 bristle-like apical av.

#### DISTRIBUTION

China (Guangxi).

#### REMARKS

The new species belongs to the *P. pallidiventris-cursitans* species-group (Chvála, 1989). It can be easily separated from other known species from China by the colouration of legs and wing pattern.

### 2. *Platypalpus guangxiensis* Yang, C. & Yang, D.

*Platypalpus guangxiensis* Yang, C. & Yang, D., 1992: 46. Type locality: Guangxi (Tianlin).

#### DIAGNOSIS

Thorax yellow but scutellum black. Abdomen yellow, but tergites medially and apically brownish. Apical projection of right genital lamella spine-like, left cercus spine-like and curved inwards apically.

#### DISTRIBUTION

China (Guangxi, Sichuan, Hubei).

### 3. *Platypalpus maoershanensis* sp. n.

Figs 6-9

#### MATERIAL

Holotype ♂, CHINA: Guangxi: Maoershan National Nature Reserve, 2100 m, light trap, 5.VII.2003, Shuwen An (CAU).

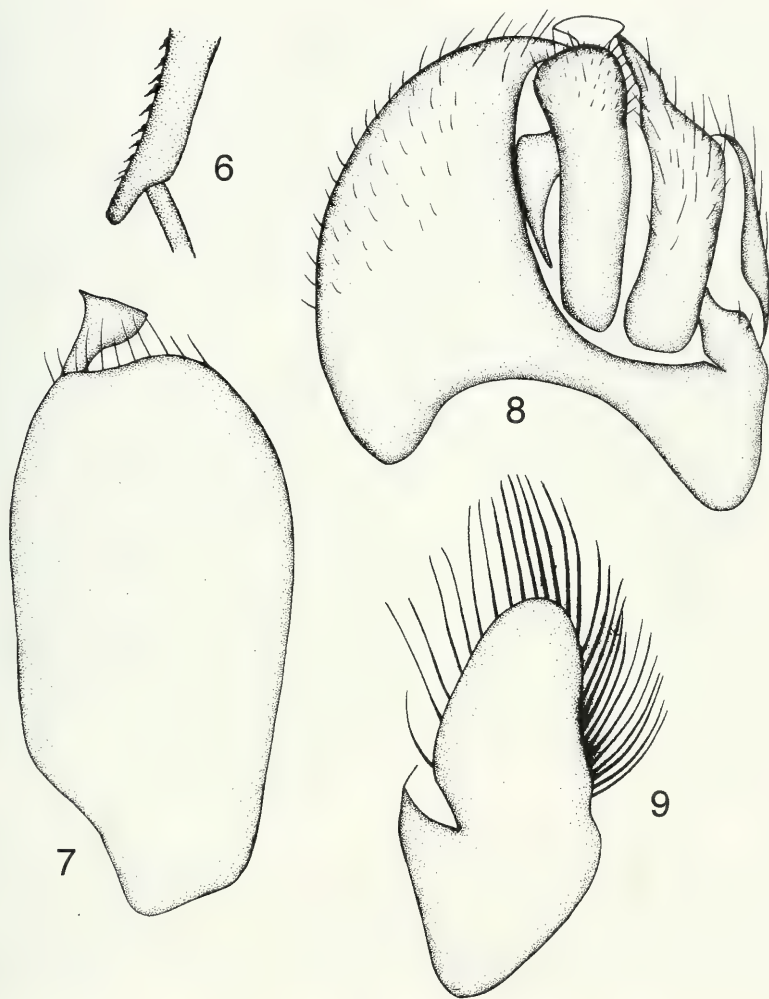
Paratype: 1 ♀, Guangxi: Maoershan National Nature Reserve, Sanjiangyuan, 1900 m, light trap, 30.VI.2003, Shuwen An (CAU).

#### ETYMOLOGY

The species is named after the type locality.

#### DIAGNOSIS

Mainly yellow species with 2 vt. Mesonotum subshiny with one rather large, black mid-longitudinal spot; h, dc and row of pv on mid femur absent. Legs yellow with dark brown tarsomere 5. Antenna yellow; first flagellomere short oval.



FIGS 6-9

*Platypalpus maoershanensis* sp. n, male. 6, apex of mid tibia; 7, right genital lamella; 8, genitalia, dorsal view (long apical bristles on left genital lamella omitted, cf. Fig. 9); 9, left genital lamella.

#### DESCRIPTION

*Male.* Body length 2.7 mm, wing length 3.3 mm.

Head black, grey microtrichose. Eyes narrowly separated on face; face slightly narrower than frons. Hairs and bristles on head pale. Ocellar tubercle with 2 oc and 2 posterior hairs; 2 vt. Antenna pale yellow; scape without dorsal hairs; pedicel with a circle of pale apical hairs; first flagellomere short oval, 1.2 times longer than wide, with short pale apical hairs; arista 4.2 times as long as first flagellomere, black, short pubescent. Proboscis yellow with blackish tip, with sparse black hairs; palpus yellow with 4 pale bristles (of which apical bristle is rather long).



Thorax yellow, thinly pale grey microtrichose; mesonotum subshiny with one rather large mid-longitudinal black spot; scutellum, metanotum and lateropleuron (= anatergite & katatergite) (except lateral portion) black. Bristles and hairs on thorax pale; h absent, 2 npl (anterior npl short, hair-like), 1 long psa, short, sparse acr nearly 6-seriate, dc absent, 1 presc (shorter and weaker than psa) in front of scutellum, scutellum with 2 pairs of sc (basal pair 1/3 as long as apical pair). Legs yellow with dark brown tarsomere 5. Bristles and hairs on legs pale; fore coxa with 4 dorsal apical bristles, mid coxa with 4 dorsal apical bristles, hind coxa with 3 dorsal apical bristles. Fore femur weakly and mid femur distinctly thickened, fore femur 1.1 times and mid femur 1.7 times as wide as hind femur; fore femur apically with 1 dorsal bristle, 1 av and 1 pv; mid femur with two rows of spine-like ventral bristles (posterior row slightly longer than anterior row, but basal ventral bristle rather long and mostly brownish yellow), without row of pv; mid tibia with a row of short blackish ventral bristles and finger-like apical spur which is longer than thickness of tibia. Wing hyaline; veins brownish yellow,  $R_{4+5}$  and M weakly convergent apically. Squama yellow with pale hairs. Halter yellow.

Abdomen yellow, thinly pale grey microtrichose; tergites 1-5 and hypopygium dark brown. Hairs on abdomen pale. Male genitalia (Figs 7-9): Left genital lamella rather elongate in dorsal view, its apical projection wide and obtuse, apically with long bristles; right genital lamella rather wide in dorsal view, its apical projection very short and with wide apex; left cercus with acute apex, right cercus with wide rounded apex.

*Female.* Body length 2.8 mm, wing length 3.1 mm. Similar to male.

#### DISTRIBUTION

China (Guangxi).

#### REMARKS

This new species cannot be placed in any of the species group defined by Chvala (1989). It is similar to *Platypalpus hamulatus* Yang & Yang, 1989, from Tibet, but the mid-longitudinal spot on mesonotum is uniformly wide. In *P. hamulatus*, the mid-longitudinal spot on mesonotum is widened towards the scutellum (Yang, D. & Yang, C., 1989).

#### 4. *Platypalpus xanthodes* sp. n.

Figs 10-13

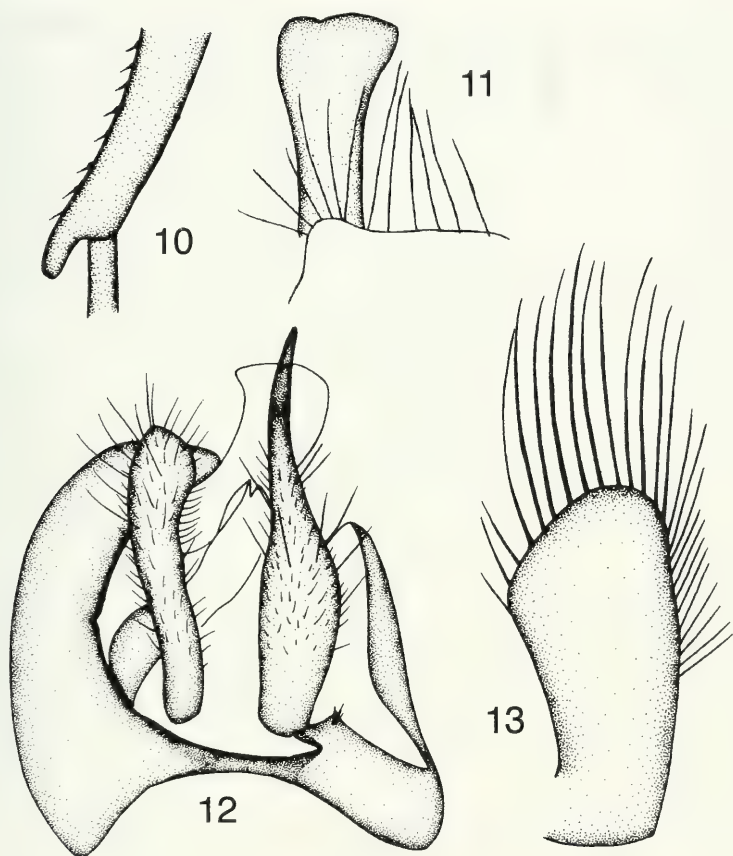
#### MATERIAL

Holotype ♂, CHINA: Guangxi: Maoershan National Nature Reserve, 1100-1600 m, 29.VI.2003, Xingyue Liu (CAU).

Paratypes: 1♂ 1♀, same data as holotype (CAU); 3♀♀, Guangxi: Maoershan National Nature Reserve, Hongjunting, 1600 m, light trap, 28.VI.2003, Xingyue Liu (CAU); 1♂, 3♀♀, Guangxi: Maoershan National Nature Reserve, Sanjiangyuan, 1900 m, light trap, 30.VI.2003, Xingyue Liu (CAU); 1♂, 3♀♀, Guangxi: Maoershan National Nature Reserve, 350 m, light trap, 3.VII.2003, Shuwen An (MNHG).

#### ETYMOLOGY

The specific name refers to the yellow thorax and abdomen. It is an invariable epithet.



FIGS 10-13

*Platypalpus xanthodes* sp. n, male. 10, apex of mid tibia; 11, apical projection of right genital lamella; 12, genitalia, dorsal view (postgonite [?] drawn as contour behind the cerci); 13, left genital lamella.

#### DIAGNOSIS

A mainly subshining yellow species with only the head capsule black; 2 vt; first flagellomere about as long as wide, arista much longer; 4 irregular rows of acr; mid femur without pv; mid tibia with an obtuse apical spur about as long as diameter of tibia; male cerci very asymmetrical; male left genital lamella with long bristles.

#### DESCRIPTION

*Male.* Body length 2.7-3.0 mm, wing length 2.9-3.1 mm.

Head black, grey microtrichose, but frons and face orange-brown microtrichose. Eyes narrowly separated on face; face narrower than frons. Bristles and hairs on head pale. Ocellar tubercle with 1 oc and 2 very short posterior hairs. Jowls almost invisible in lateral view; 2 vt. Antenna yellow; scape without dorsal hairs; pedicel with a circle of mostly pale apical hairs; first flagellomere short oval, 1.1 times as long as

wide, with some hairs; arista very long, 3.5-3.7 times as long as first flagellomere, brown, short pubescent. Proboscis yellow with brown hairs; clypeus yellow, microtrichose; palpus yellow with 3 long pale bristles, the apical one much longer than the others.

Thorax yellow, thinly grey microtrichose; mesonotum subshiny, without darker stripe; katapisternum with indistinct shining yellow spot medially; meron with a small longitudinal, black spot. Hairs on thorax pale, bristles brownish yellow; 1 short hair-like h curved inward, 2 npl (anterior npl short and hair-like), acr in 4-6 irregular rows, dc not longer than acr, 1 long psa, 1 weak presc in front of scutellum, scutellum with 2 pairs of sc (basal pair very short, 1/3 of apical pair). Legs yellow, but tarsomere 5 slightly brownish apically. Hairs on legs pale. Fore femur weakly and mid femur distinctly thickened, fore femur 1.2 times and mid femur 1.7 times as wide as hind femur; mid femur with two rows of short black ventral bristles (posterior row longer than anterior row, but ventral bristles on basal quarter long and brownish yellow), without row of pv; mid tibia (Fig. 10) with a row of blackish ventral bristles, finger-like apical spur about as long as diameter of tibia. Wing hyaline; veins brownish yellow; crossveins contiguous;  $R_{4+5}$  and M parallel apically. Squama yellow with pale hairs. Halter yellow.

Abdomen yellow, pale grey microtrichose; hypopygium mostly yellow. Hairs on abdomen pale. Male genitalia (Figs. 11-13): Left genital lamella rather narrow, its apical projection wide and obtuse apically, and with long apical bristles; right genital lamella slightly wide in dorsal view, its apical projection short with wide and obtuse apex; left cercus long with spine-like apex, right cercus shorter with obtuse apex.

*Female.* Body length 2.7-3.1 mm, wing length 2.8-3.2 mm. Similar to male.

#### DISTRIBUTION

China (Guangxi).

#### REMARKS

The new species belongs to the *P. longicornis* species-group of Chvála (1989). It is very similar to *Platypalpus guangxiensis* Yang & Yang from Guangxi, Sichuan and Hubei, but can be separated from the latter by the yellow scutellum and right surstylus with wide obtuse apex. In *guangxiensis*, the scutellum is black, and the right surstylus has an acute apex (Yang, C. & Yang, D., 1992).

#### CONCLUSIONS

Guangxi belongs to South China which is considered to be part of the Oriental region with a subtropical and tropical climate. Although *Platypalpus* is basically a genus of temperate regions, it is noteworthy that 4 species are known to occur in this province. However, they were all found at higher altitude (above 1000 m, only one record of *P. xanthodes* from 350 m). Among them the three new species are endemic to Guangxi so far. The only already known species has a much wider distribution with records extending to Sichuan and Hubei in Central China region. Taking into account the bad collecting effort in Guangxi it is well possible that more species will eventually be found in this province.



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## **A contribution to the knowledge of the Chyromyidae (Diptera) of Italy with description of a new species of *Aphaniosoma* Becker**

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**A contribution to the knowledge of the Chyromyidae (Diptera) of Italy with description of a new species of *Aphaniosoma* Becker.** - The family Chyromyidae is reported from Sicily (eleven species) and from Sardinia (nine species). Additional records of species for mainland Italy are also given. A new species of *Aphaniosoma* is described from France, Sicily and Sardinia. A total of eleven species are new to Italy: *Chyromya miladae*, *Gymnochiromyia fallax*, *G. flavella*, *G. inermis*, *G. mihalyii*, *Aphaniosoma collini*, *A. claridgei*, *A. grisescens*, *A. micromacro*, *A. proximum*, and *A. bifalcatum* sp. n. A list is given of all the seventeen species so far recorded for Italy and its larger islands, together with their data and their distribution in the West Palaearctic.

**Keywords:** Diptera - Chyromyidae - *Aphaniosoma bifalcatum* sp. n. - Italy - Sardinia - Sicily - France.

### **INTRODUCTION**

The family Chyromyidae of Italy has not been well studied and there are no published records from Sardinia or from Sicily. In the Checklist of the Diptera of Italy (Canzoneri *et al.*, 1995) only three species are listed, namely: *Chyromya flava* (Linnaeus, 1758), *C. oppidana* (Scopoli, 1763) and *Aphaniosoma nigrohirtum* (Hendel, 1933). All occur in the north of Italy. The two species of *Chyromya*, according to the Checklist, also occur in the south. The Catalogue of Palaearctic Diptera (Soós, 1984) gives only *A. nigrohirtum* as specifically occurring in Italy. Thus, both works overlooked or did not accept the record, based on a single specimen deposited in the Museum of Natural History in Vienna, of *A. approximatum* Becker, which was given in Die Fliegen der Paläarktischen Region (Czerny, 1927). However, this specimen was re-examined and it belonged not to *approximatum*, but to a new species, *egregium* Ebejer (1998b); in the same paper, *A. melitensis* Ebejer and *A. propinquans* Collin were also recorded from Italy.

Recent studies of this family of Diptera (Ebejer, 1998a, b; Carles-Tolrá, 2001) have revealed that there are many more species in the Mediterranean. Thus, the list given in the Catalogue of Palaearctic Diptera (Soós, 1984) is now very out of date. During a brief visit to Sicily in the spring of 1999, eleven species of Chyromyidae were



encountered. Dr Merz found nine species in Sardinia in the spring of 2002 and Dr Gatt collected three species in Tuscany in the summer of 2003. They are listed in this article with their data and summarised in Table 1. Eleven of these species are new records for Italy.

TABLE 1: The Italian species of Chyromyidae. (The north and south Italian regions are according to the Checklist of the Diptera of Italy.)

	North Italy	South Italy	Sardinia	Sicily
1. <i>Chyromya flava</i> (Linnaeus)	x			x
2. <i>Chyromya miladae</i> Andersson				x
3. <i>Chyromya oppidana</i> (Scopoli)	x			x
4. <i>Gymnochiromyia fallax</i> Ebejer			x	
5. <i>Gymnochiromyia flavella</i> (Zetterstedt)			x	
6. <i>Gymnochiromyia inermis</i> (Collin)			x	x
7. <i>Gymnochiromyia mihalyii</i> Soós			x	x
8. <i>Aphaniosoma bifalcatum</i> sp. nov.			x	x
9. <i>Aphaniosoma claridgei</i> Ebejer		x	x	x
10. <i>Aphaniosoma collini</i> Lyneborg			x	
11. <i>Aphaniosoma egregium</i> Ebejer	x			x
12. <i>Aphaniosoma grisescens</i> Ebejer			x	
13. <i>Aphaniosoma melitensis</i> Ebejer		x	x	x
14. <i>Aphaniosoma micromacro</i> Carles-Tolrá		x		
15. <i>Aphaniosoma nigrohirtum</i> Hendel	x			
16. <i>Aphaniosoma propinquans</i> Collin	x			x
17. <i>Aphaniosoma proximum</i> Ebejer			x	x

## MATERIAL AND METHODS

Specimens were collected by hand-net sweeping only. All the material, which is cited in this article, is dry mounted and deposited in the personal collections of the collectors or their Institutions [Dr Deeming – National Museum of Wales, Cardiff, UK (NMWC); Dr P. Gatt – Rabat, Malta; Dr B. Merz – Museum of Natural History, Geneva, Switzerland (MHNG); and in the author's collection (MJE)].

In the course of this study a number of specimens similar to *A. claridgei* Ebejer could not be identified with certainty. Detailed examination showed these to belong to a new species and this is described below.

For the identification to species, the reader is referred to the following literature: for the genus *Chyromya* - Andersson, 1971, 1976; for *Gymnochiromyia* - Soós, 1979, Ebejer, 1998a; and for *Aphaniosoma* - Collin, 1949; Ebejer, 1993, 1998b, Carles-Tolrá, 2001.

The nomenclature of the hypopygium that is used in this article takes into account the terminology given in the Contributions to a Manual of Palaearctic Diptera (Sinclair, 2000). The term gonostylus is retained for the time being, since there are uncertainties of homologies with regard to this structure. It is so identified because it articulates with the posterior end of the hypandrium and in many *Aphaniosoma* it bears sensory setulae (absent in the species). The term corresponds to terminology used in recent literature on the Chyromyidae (Ebejer, 1998a, b).

## RESULTS

*Chyromya flava* (Linnaeus, 1758)

*Material examined.* ITALY: SICILY: 3 ♂♂, 2 ♀♀, Catania, Randazzo, Monte Spagnolo, 1200 m, grassland, edge of woodland of *Acer*, *Castanea*, *Pinus*, 6.vi.1999, J.C. Deeming; 1 ♀, same data, but M.J. Ebejer; 1 ♂, 8 ♀♀, same data, but B. Merz; 1 ♂ and 1 ♀, Messina, Nebrodi, Cesarò, 1150 m, on *Tilia*, 8.vi.1999, J.C. Deeming; 1 ♀, Messina, Nebrodi, Troina, Elia River, 1000 m, 8.vi.1999, M.J. Ebejer; 8 ♂♂, 12 ♀♀, Catania, Randazzo, Lago di Gurrida, *Quercus*, *Populus*, 870 m, 11.vi.1999, M.J. Ebejer; 3 ♂♂, 5 ♀♀, same data, but B. Merz.

This is one of the commonest and most widespread species in the family. It is also known from North America and North Africa. It has been observed in good numbers on and beneath leaves of isolated broad-leaved trees, especially *Tilia* and *Populus*, growing at the edge of open woodland. New to Sicily.

*Chyromya miladae* Andersson, 1976

*Material examined.* ITALY: SICILY: 1 ♀, Catania, Randazzo, Lago di Gurrida, *Quercus*, *Populus*, 870 m, 11.vi.1999, M.J. Ebejer.

Described from the Czech Republic and later recorded from Slovakia, this species was recently listed as occurring in Britain (Chandler, 1998). This uncommon species is probably associated with broad-leaved woodland. New to Sicily.

*Chyromya oppidana* (Scopoli, 1763)

*Material examined.* ITALY: SICILY: 1 ♀, Catania, Randazzo, Lago di Gurrida, *Quercus*, *Populus*, 870 m, 11.vi.1999, M.J. Ebejer.

This species is as frequent as *flava* and it has the same wide distribution and habits. New to Sicily.

*Gymnochiromyia fallax* Ebejer, 1998

*Material examined:* ITALY: SARDINIA: 5 ♀♀, Nuoro reg., 120 m, 8 km E of Oliena, Hotel su Gologone, 16.vi.2002, B. Merz & M. Eggenberger.

This species is typically found in saltmarshes and coastal regions. It was described from Malta, but it is also found in Mallorca. New to Sardinia.

*Gymnochiromyia flavella* (Zetterstedt, 1848)

*Material examined:* ITALY: SARDINIA: 1 ♀, Baunei reg., Santa Maria Navarrese, 18.vi.2002, B. Merz & M. Eggenberger.

Widespread in Europe and probably all the Palaearctic including North Africa. New to Sardinia.

*Gymnochiromyia inermis* (Collin, 1933)

*Material examined:* ITALY: SARDINIA: 1 ♀, Villacidro reg., 600 m, Nuxeddu Mts., Montimannu forest, 12.vi.2002, B. Merz & M. Eggenberger; 1 ♀, Nuoro reg., Monte Albo 1120 m, Punta Catirina, 16.vi.2002, B. Merz & M. Eggenberger. SICILY: 2 ♂♂, 3 ♀♀, Messina, Nebrodi, Troina, Lago D'Ancipa, mixed woodland, 8.vi.1999, M.J. Ebejer; 1 ♀ same data, B. Merz; 1 ♀, Catania, Randazzo, Monte Spagnolo, 1200 m, grassland, *Acer*, *Castanea*, *Pinus*, 6.vi.1999, M.J. Ebejer; 1 ♀, same data, but B. Merz; 1 ♀, Messina, Bronte, Monte Minardo, *Quercus* forest, 345 m, 11.vi.1999, M.J. Ebejer; 1 ♀, same data, but J.C. Deeming.

When Collin (1933) described this species, he gave a number of examples of birds' nests from where it was reared. Deeming (1998) described the puparium and cephalopharyngeal skeleton. It is a common species and it is the most likely member of the genus to be found at some altitude and in broad-leaved woodland. New to Sardinia and Sicily.

***Gymnochiromyia mihalyii* Soós, 1979**

*Material examined:* ITALY: SARDINIA: 1♂, 5♀♀, Nuoro reg., Monte Albo 1120 m, Punta Catirina, 16.vi.2002, B. Merz & M. Eggenberger; 1♂, Dorgali, Rio Flumineddu, Gola di Gorropu, 15.vi.2002, B. Merz & M. Eggenberger. SICILY: 1♀, Catania, Etna, 3 km NW of Milo, *Castanea*, *Corylus*, 1000 m, 5.vi.1999, M.J. Ebejer.

Carles-Tolrá (1992) recorded this species from Spain and Merz (1997) recorded it from Switzerland. The present author has specimens from Britain, Turkey and Greece. It is probably widespread in several Mediterranean countries. Unlike *inermis*, it seems to prefer open countryside including dunes and cultivated fields. New to Sardinia and Sicily.

***Aphaniosoma bifalcatum* sp. n.**

Figs 1-3

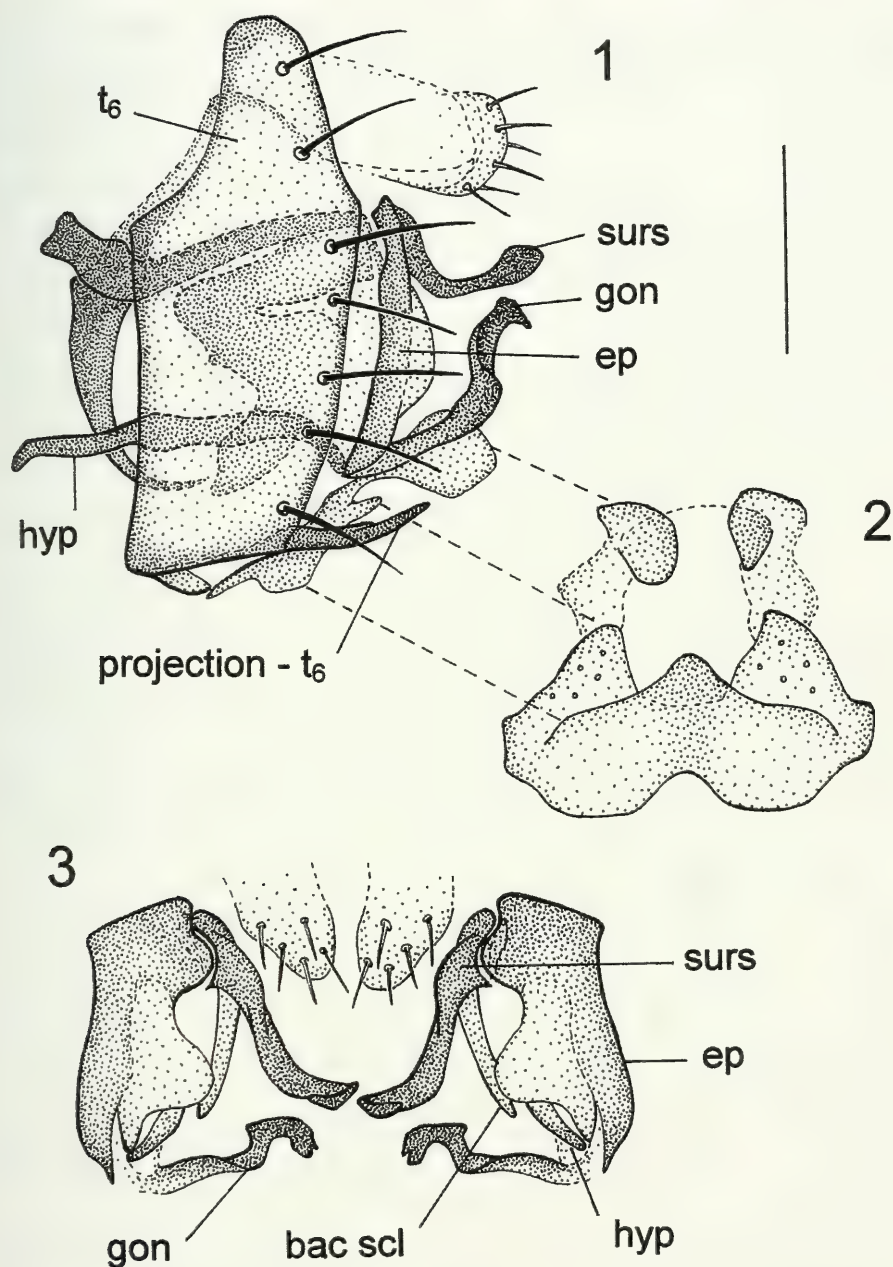
*Material examined:* Holotype: ♂, ITALY: SARDINIA: Dorgali reg., 350 m, Cala Luna South of Cala Gonone, 17.vi.2002, B. Merz & M. Eggenberger (MHNG). Paratypes: 1♂, 2♀♀, same data and depository; 1♂, same data, but in MJE; 1♂, Bosa reg., 0 m, Bosa Marina, 20.vi.2002, B. Merz & M. Eggenberger (MHNG). SICILY: 1♂, 1♀, Siracusa, Noto, Vendicari, coastal marshes and dunes, M.J. Ebejer (MJE). FRANCE: 2♂♂, 4♀♀, Montpellier, Lotte salt-marsh, 23.viii.2000, J.C. Deeming (NMWC).

A dark brownish black species of the *approximatum* Becker group characterized by a pair of long frontal setae anterior to the ocellar triangle and long narrow dark surstyli.

Holotype, male. *Head:* yellow, ocellar triangle black, occiput deep black except for narrow, yellow postocular margin; frons at vertex about half width of head; frons, antenna, gena and mouth parts all yellow; third antennal segment with distinct setulae anteriorly, arista black except for yellow basal segments; gena about half as high as eye; chaetotaxy: a pair of very long frontal setae present on frons in front of ocellar triangle and 8 pairs of pale setulae scattered on frons, 2 long orbitals and 2 shorter ones in front of these, 1 internal and 1 external vertical.

*Thorax:* black with dark grey dusting becoming brownish in prescutellar depression and on scutellum; scutellum with pale apical margin; humerus and notopleural depression clear yellow; pleura all dark brownish black except for narrow yellow margins to sutures; metanotum black; chaetotaxy: 1 humeral, 1 posthumeral, 2 notopleural, the anterior, strongly developed – about twice as long as posterior; 2+5 dorso-centrals, but only the prescutellar strong, 2+4 acrostichals, 3 intra-alar, 1 post-alar and 0 supra-alar, 2 pairs of marginal scutellars; 1 mesopleural with 4 short setulae in vertical row below this, 1 sternopleural at posterior upper corner, and 4 setulae in vertical row at anterior part; stigmal setula present. Wing: broad, hyaline with anterior cross vein pale yellow and other veins all brownish, becoming darker towards apex; distance between cross veins about 1.2 times length of posterior cross vein; distance between  $R_{2+3}$  and  $R_{4+5}$  on costa is half that between  $R_{4+5}$  and  $M_{1+2}$ . Haltere:





FIGS 1-3

*Aphaniosoma bifalcatum* sp. n., male terminalia. 1, hypopygium lateral aspect; 2, pregenital sternite; 3, hypopygium posterior aspect; abbreviations: bac scl = bacilliform sclerite, ep = epandrium, gon = gonostylus, hyp = hypandrium, surs = surstylus, t6 = sixth tergite; scale bar = 0.1mm.

yellow. Legs: all yellow except for 5<sup>th</sup> tarsal segment of all legs – this being broadly infuscated around margin; hind coxa simple and brownish at base.

*Abdomen*: tergites black with narrow pale posterior margins; epandrium with shiny pale brown spot at base near cerci, which are relatively long, yellow and pale-haired.

*Hypopygium* (Figs 1-3): typical of the *approximatum* Becker - *creperum* Collin group, having an internalised and reduced epandrium with prominent dark surstyli visible externally; distiphallus poorly sclerotized and relatively amorphous; bacilliform sclerite and gonostylus prominent, darkly pigmented and heavily sclerotized; gonostylus articulates with posterior arm of hypandrium very close to where this articulates with inferior margin of epandrium.

*Female*. As in male, but without secondary sexual characters; apex of abdomen with tergite 7 strongly curved on sides to form a broad and short conical cavity with the cerci deep within; apical 2 sternites, in middle third, heavily sclerotized and dark shiny brown pigmented.

*Variation*. The males from France and the one from Bosa in Sardinia have a greyish yellow scutellum and a dusky yellow prescutellar area; the grey mesonotal pattern fades posteriorly except in the middle where it reaches the scutellar margin and, laterally, the yellow area extends forwards along the intra-alar line; the pleura have the sutures more broadly yellow and the hind marginal bands of the tergites are broader, especially laterally. The colour variations are present also in the females from France. A male paratype from France was dissected and is identical to the paratype from Sardinia, which is illustrated in the figure.

*Similar species*. The nominate form resembles the dark species of the *claridgei* Ebejer group, whereas the paler form resembles *grisescens* Ebejer and *proximum* Ebejer. If the surstyli are properly extruded, then *bifalcatum* can be recognised because these structures are sinuous and the apex is somewhat spatulate.

*Etymology*. The curved surstylus together with the sinuate gonostylus gives an appearance of two sickles (Latin singular: falx) on each side of the postabdomen.

### *Aphaniosoma claridgei* Ebejer, 1995

*Material examined*: ITALY: TOSCANA: 3♂♂, 7♀♀, Parco Nazionale della Maremma, Collelungo, Bonifica Canal, 2.ix.2003, P. Gatt; 2♂♂, 15♀♀, plus 8♀♀ in alcohol, Parco Nazionale della Maremma, Bocca D'Ombrone estuary, saltmarsh, 2.ix.2003, P. Gatt; 3♂♂, 4♀♀, Parco Nazionale della Maremma, Collelungo, beach and dunes, 2.ix.2003, P. Gatt. SARDINIA: 3♂♂, 1♀, Dorgali reg., 350 m, Cala Luna South of Cala Gonone, 17.vi.2002, B. Merz & M. Eggenberger; 3♂♂, 3♀♀, Bosa reg., 0 m, Bosa Marina, 20.vi.2002, B. Merz & M. Eggenberger; 13♂♂, 3♀♀, Cuglieri Reg., Sinis Peninsula, 0 m, Capo Mannu, 21.vi.2002, B. Merz & M. Eggenberger. SICILY: 6♂♂, 3♀♀, Siracusa, Noto, Vendicari, coastal marshes and dunes, M.J. Ebejer; 11♂♂, 16♀♀, same data, but B. Merz; 2♂♂, 5♀♀, same data, but J.C. Deeming.

A typical salt marsh species with a preference for coastal areas, it is widespread in the Mediterranean. It is often the dominant species of the genus in such habitats. There are many similar species in this group. New to Italy: Sardinia and Sicily.

### *Aphaniosoma collini* Lyneborg, 1973

*Material examined*: ITALY: SARDINIA: 2♂♂, Bosa reg., Bosa Marina, 0 m, 20.vi.2002, B. Merz & M. Eggenberger.

This species was described from Spain. It is common in Tunisia, Mallorca, France and Malta and may be one of the more widespread species in the group with projections on the hind trochanter in the male. New to Sardinia.

***Aphaniosoma egregium* Ebejer, 1998**

*Material examined:* ITALY: SICILY: 1 ♂, Siracusa, Noto, Vendicari, coastal marshes and dunes, J.C. Deeming (MJE).

This is a distinctive, but one of the most uncommon species of *Aphaniosoma*. Other than the types, very few specimens of this species have been seen. New to Sicily.

***Aphaniosoma grisescens* Ebejer, 1998**

*Material examined:* ITALY: SARDINIA: 2 ♂♂, Dorgali reg., 350 m, Cala Luna South of Cala Gonone, 17.vi.2002, B. Merz & M. Eggenberger; 1 ♂, Baunei reg., Santa Maria Navarrese, 18.vi.2002, B. Merz & M. Eggenberger; 2 ♂♂, 1 ♀, Cuglieri Reg., Sinis Peninsula, 0 m, Capo Mannu, 21.vi.2002, B. Merz & M. Eggenberger; 3 ♂♂, Bosa reg., 0 m, Bosa Marina, 20.vi.2002, B. Merz & M. Eggenberger.

Described from Tunisia, it is also known from Malta. Not a common species, but it can easily be confused with *claridgei* and *proximum*. New to Sardinia.

***Aphaniosoma melitensis* Ebejer, 1993**

*Material examined:* ITALY: TOSCANA: 1 ♂, 2 ♀♀, Parco Nazionale della Maremma, Collelungo, Bonifica Canal, 2.ix.2003, P. Gatt; 1 ♀, Parco Nazionale della Maremma, Bocca D'Ombrone estuary, saltmarsh, 2.ix.2003, P. Gatt. SARDINIA: 2 ♂♂, 8 ♀♀, Dorgali reg., 350 m, Cala Luna South of Cala Gonone, 17.vi.2002, B. Merz & M. Eggenberger; 2 ♀♀, Baunei reg., Santa Maria Navarrese, 18.vi.2002, B. Merz & M. Eggenberger; 8 ♂♂, 1 ♀, Bosa reg., 0 m, Bosa Marina, 20.vi.2002, B. Merz & M. Eggenberger; 1 ♂, 1 ♀, Cuglieri Reg., Sinis Peninsula, 0 m, Capo Mannu, 21.vi.2002, B. Merz & M. Eggenberger. SICILY: 3 ♂♂, 3 ♀♀, Siracusa, Noto, Vendicari, coastal marshes and dunes, M.J. Ebejer; 2 ♂♂, 16 ♀♀, same data, but B. Merz; 2 ♂♂, 8 ♀♀, same data, but J.C. Deeming.

This is another common species known from several European countries where it inhabits flushed meadows, marshes and dunes. It is a polymorphic species with small very dark forms appearing quite different from the large pale specimens. There is also variation as to how rounded are the apical projections on the ventral aspect of the fourth tergite in the male. All intermediates exist within the same population if a large enough sample is examined. New to Sicily and Sardinia.

***Aphaniosoma micromacro* Carles-Tolrà, 2001**

*Material examined:* ITALY: TOSCANA: 2 ♂♂, 6 ♀♀, Parco Nazionale della Maremma, Collelungo, beach and dunes, 2.ix.2003, P. Gatt.

Described from Spain, this species is one of the very few with modified tarsi. It is also known from Malta. New to Italy.

***Aphaniosoma propinquans* Collin, 1949**

*Material examined:* ITALY: SICILY: 2 ♂♂, 2 ♀♀, Siracusa, Noto, Vendicari, coastal marshes and dunes, M.J. Ebejer.

Originally described from Britain, this species is now known to have a wide distribution in Europe. It is relatively easy to identify in both sexes and so it should not be overlooked. New to Sicily.



### *Aphaniosoma proximum* Ebejer, 1998

*Material examined*: ITALY: SARDINIA: 1 ♀, Bosa reg., 0 m, Bosa Marina, 20.vi.2002, B. Merz & M. Eggenberger; 2 ♂♂, Cuglieri Reg., Sinis Peninsula, 0 m, Capo Mannu, 21.vi.2002, B. Merz & M. Eggenberger. SICILY: 6 ♂♂, 7 ♀♀, Siracusa, Noto, Vendicari, coastal marshes and dunes, M.J. Ebejer; 1 ♂, 4 ♀♀, same data, but B. Merz.

This species belongs to the *approximatum* Becker group. It is difficult to identify without dissection. It is probably widespread in the Mediterranean, but overlooked. New to Sardinia and Sicily.

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## **Hemiscorpiidae (Scorpiones) from Iran, with descriptions of two new species and notes on biogeography and phylogenetic relationships**

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**Hemiscorpiidae (Scorpiones) from Iran, with descriptions of two new species and notes on biogeography and phylogenetic relationships.** - The family Hemiscorpiidae is closely related to the Liochelidae. Within the Hemiscorpiidae, the Oriental species are particularly interesting. Most of them exhibit highly derived characters in comparison to their African relatives. Males possess a strongly elongated metasoma and a similarly elongated telson bearing a pair of tuberculiform processes at the base of the aculeus. Furthermore, *Hemiscorpius lepturus* Peters, 1861, which occurs in Iraq and Iran, is known to have an extremely virulent venom with cytotoxic and haemolytic components. It is responsible for severe dermonecrotic scorpionism in southern Iran. This is the only non-buthid scorpion that is potentially lethal. In this paper an overview of the species of *Hemiscorpius* in Iran is presented with revised diagnoses and descriptions. Two new species from western Iran, *H. enischnochela* sp. n. and *H. acanthocercus* sp. n., are described. The genus *Habibiella* Vachon, 1974 is synonymised with *Hemiscorpius* Peters, 1861. A thorough analysis of hemispermatophores shows close phylogenetic relationships with several genera of the family Liochelidae. A hypothesis on the geological events that probably triggered the present distribution of *Hemiscorpius* is finally proposed.

**Keywords:** Scorpiones - Hemiscorpiidae - *Hemiscorpius* - new species - new synonymy - Iran - hemispermatophore - Liochelidae.

## **INTRODUCTION**

The family Hemiscorpiidae Pocock, 1893 was formerly considered as a subfamily (Hemiscorpiinae) of the Scorpionidae Latreille, 1802 (Fet, 2000). Sissom (1990) criticised the placement of the Hemiscorpiinae in the Scorpionidae, but did not suggest an alternative. Stockwell (1989) first suggested the transfer of Hemiscorpiinae directly from the Scorpionidae to the Ischnuridae, where they retained their subfamily rank. Recently Lourenço (2000) and Prendini (2000) simultaneously elevated the

Hemiscorpiinae to family level. While Lourenço did not give any justification, Prendini provided a detailed phylogenetic analysis where he demonstrated that Hemiscorpiidae is the sister group of Ischnuridae Simon, 1879, now Liochelidae Fet & Bechly, 2001. Solegad & Fet (2003) confirmed the phylogeny of Scorpionoidea established by Prendini (2000), but downgraded the Hemiscorpiidae from family to subfamily rank under Liochelidae. Until the discussion is settled, we decided to follow Lourenço's and Prendini's view and consider the hemiscorpiids as a family.

Two genera were traditionally listed in the family Hemiscorpiidae (see Fet, 2000), *Habibiella* Vachon, 1974 and *Hemiscorpius* Peters, 1861a. *Habibiella* is a monotypic genus, the type species, *H. gaillardi*, was described by Vachon (1974) from a single female collected in eastern Iran. This genus is here placed in the synonymy of *Hemiscorpius*. The genus *Hemiscorpius* in the traditional sense includes six species which occur from Somalia to Pakistan, most of them in the Middle East (Fet, 2000). These are: *H. arabicus* (Pocock, 1899a), *H. lepturus* Peters, 1861a, *H. maindroni* (Kraepelin, 1900), *H. persicus* Birula, 1903, *H. socotranus* Pocock, 1899b and *H. tellinii* Borelli, 1904. Species of *Hemiscorpius* and *Habibiella gaillardi* (now under *Hemiscorpius*) are morphologically very similar and were distinguished only by their trichobothriotaxy. *Habibiella* is neobothriotaxic major, with 10-12 trichobothria on the ventral side of the pedipalp patella instead of 3 as in the species previously comprising *Hemiscorpius*, and 15 trichobothria on the external side of the pedipalp patella instead of 13.

Three species belonging to the family Hemiscorpiidae are known to occur in Iran: *H. gaillardi*, *H. lepturus* and *H. persicus*. *H. lepturus* is of particular medical interest. This species is the only dangerous and potentially lethal scorpion that does not belong to the family Buthidae. It is responsible for significant scorpionism problems in the southern provinces of Iran. The venom of *H. lepturus* is highly cytotoxic and haemolytic and can cause serious wounds and skin inflammations whereas other scorpions have a neurotoxic venom. The deep dermonecrotic ulcers and blisters caused by such a sting are slow and difficult to heal and therefore usually result in very unpleasant scars. Severe complications such as serious haemolysis, internal haemorrhages, secondary renal failure and death were also reported (Radmanesh, 1990, 1998). Venoms with such cytotoxic and hemolytic effects are also quite uncommon in spiders and only known in three genera, i. e. *Cheiracanthium* C.L. Koch, 1839 (Miturgidae), *Loxosceles* Heineken & Lowe, 1832 (Sicariidae) and *Sicarius* Walckenaer, 1847 (Sicariidae), (Filmer, 1999). While severe envenomations in humans by *Cheiracanthium* and *Sicarius* are not known, the virulent poison of the Brown Recluse Spider, *Loxosceles reclusa* Gertsch & Mulaik, 1940, and its enzymatic activities have been extensively studied (Anderson, 1998; Butz *et al.*, 1971; Dillaha *et al.*, 1964; Foil *et al.*, 1979; Patek *et al.*, 1994). Among the 13 species of *Loxosceles* present in the United States (at least 5 of them are associated with necrotic arachnidism), *L. reclusa* is most commonly responsible for dermonecrotic arachnidism in North America. Brown spiders are also of significant clinical concern in South America, with *L. laeta* (Nicolet, 1849) being responsible for several deaths each year. In Iran cases of scorpion envenomation with cutaneous and viscerocutaneous reactions are usually attributed to the species *H. lepturus*. Species of *Hemiscorpius* are morphologically very close to each

other and difficult to distinguish for a non-specialist, therefore we assume that *H. lepturus* is probably not the only species responsible for all envenomations in that country. Other *Hemiscorpius* species probably possess venoms with similar necrotic effects.

As stated by Fet (2000), there is no recent revision and no dichotomic key for *Hemiscorpius*. In the past 40 years several checklists of scorpions from Iran, which also include *Hemiscorpius* species, have been published (Vachon, 1966; Habibi, 1971; Farzanpay & Pretzmann, 1974; Pérez-Minnocci, 1974; Farzanpay, 1988; Kinzelbach, 1985; Kovařík, 1997). However, neither precise descriptions, nor specific diagnoses were included in these publications. The extensive cladistic analysis of Scorpionoidea by Prendini (2000) gives a precise diagnosis and description for the family, but not for the two species used in that study, i. e. *H. lepturus* and *H. maindroni*. Early descriptions are very short and not accurate enough, and therefore do not allow species identification. The present paper gives an overview of the hemiscorpiids of Iran, with revised diagnoses and redescriptions of *H. gaillardi*, *H. lepturus* and *H. persicus*. *H. enischnochela* sp. n. and *H. acanthocercus* sp. n. are described from the region of Bandar Abbas, Hormozgan Province, south-eastern Iran. This study also allowed to clarify the taxonomic position of the enigmatic genus *Habibiella*, which is here synonymised with the genus *Hemiscorpius*. Strong evidence of a close phylogenetic relationship with the Iiochelids *Iomachus politus* Pocock, 1896, *Hadogenes* Kraepelin, 1894 and *Opisthacanthus* (*Opisthacanthus*) Peters, 1861b is pointed out by the examination of hemispermatophore morphology. Finally a hypothesis on the geological events that presumably triggered the evolution and present distribution of the family is proposed.

## MATERIAL AND METHODS

Illustrations were produced by using a Wild M5 stereo-microscope with a drawing tube. Trichobothrial notations and terminology of metasomal carination follow Vachon (1974), measurements follow Stahnke (1970) and are given in mm. Additional morphological terminology mostly follows Hjelle (1990) and Sissom (1990), terminology of carination of pedipalpal chela follows Prendini (2000). Hemispermatophore terminology is modified from the terminology applied by Lamoral (1979) and was used by Monod & Volschenk (2004). The distribution map was generated with ArcView® GIS 3.1, maps and drawings were subsequently edited in Adobe Illustrator® 8.0 and Adobe Photoshop® 6.0.

## LIST OF ACRONYMS

BPBM	Bernice P. Bishop Museum, Honolulu, Hawaii.
CAS	Californian Academy of Sciences, San Francisco, USA.
MHNG	Muséum d'histoire naturelle, Genève, Switzerland.
MNHN	Muséum National d'Histoire Naturelle, Paris, France.
NHMW	Naturhistorisches Museum Wien, Austria.
ZISP	Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.
ZMB	Zoologisches Museum, Humboldt Universität, Berlin, Germany.



## SYSTEMATICS

**HEMISCORPIIDAE** Pocock, 1893

Hemiscorpinii Pocock, 1893: 306, 308. Type genus *Hemiscorpius* Peters, 1861a.

*Diagnosis* (modified from Prendini, 2000). The Hemiscorpiidae can be distinguished from all other scorpionoid taxa by their trichobothriotaxy: trichobothria *ib* and *it* of the pedipalp chela are situated midway on the finger, whereas both are at the base of the fixed finger in all other scorpionoid taxa except Nebinae and *ib* is situated basally and *it* distally on the fixed finger in Nebinae, Diplocentridae. Hemiscorpiids also differ from other scorpionoid taxa, except for Heteroscorpionidae and Urodacidae, by their metasomal segments I-IV, which bear a single ventromedian carina equally developed on all segments. Hemiscorpiidae can be distinguished from the Heteroscorpionidae and Urodacidae by the following characters: (1) 3 pairs of lateral ocelli present; (2) median ocular tubercle shallow; (3) movable cheliceral finger with distal external and distal internal teeth approximately equal in size and closely opposed; (4) pedipalp chela fingers with 2 primary rows of denticles often fused at the base; (5) trichobothrium *db* located on internal surface of fixed finger; (6) trichobothrium *Db* located basally on dorsal surface of manus; (7) trichobothrium *Dt* located at proximal end of fixed finger; (8) no accessory trichobothria in *v* series of chela; (9) telson vesicle of male elongated and laterally compressed; (10) hemispermatophores with a double lamellar hook and a complex median capsular structure.

*Remarks.* Telson vesicles of mature *Hemiscorpius leturus* males are unusually elongated, laterally compressed, and bear a pair of distal lobes at the base of aculeus (Fig. 1A-B), whereas females possess bulky telsons, which are laterally not compressed and have no distal lobes. Subadult males do not have an extremely elongated metasoma and a modified telson like mature males have, their metasoma and telson are just slightly more elongated than in females. These secondary sexual characters appear only in the last developmental instar. In Prendini's (2000) cladistic interpretation of relationships within the superfamily Scorpionoidea this very unusual feature is considered as a valid character for the whole family Hemiscorpiidae and is mentioned in the diagnosis: telsons of *H. lepturus* and *H. maindroni* males are described as possessing an extreme elongation and paired distal lobes. Our examination of syntypes of *Hemiscorpius maindroni* from Mascate also revealed a pronounced sexual dimorphism but not as extreme as in *H. lepturus*. Indeed *H. maindroni* males possess telsons (Fig. 1G-H) without any distal lobes or elongation as in *H. lepturus*. Therefore the species identified as *H. maindroni* in Prendini's cladistic revision of the superfamily Scorpionoidea (2000) undoubtedly belongs to another species. All the other non-Iranian hemiscorpiids examined, i. e. *H. socotranus*, *Hemiscorpius* spp. from Somalia, Eritrea and Djibouti possess a simple telson and a less elongated metasoma than in *H. maindroni* (Fig. 27A-B). The Iranian hemiscorpiids *H. acanthocercus* sp. n., *H. enischnochela* sp. n., *H. lepturus* and probably also *H. gaillardi* can therefore be placed together in the *H. lepturus* species complex. However, the Iranian *H. persicus* does not belong to this group. The mature male holotype studied does not have modified metasoma and telson.

Prendini (2000) described the hemispermatophores of hemiscorpiids as possessing a single lamellar hook. In his data matrix (Table 3, p. 6), the character 90

(hemispermatophore, lamellar hook) is coded 0 (single hook) for both *H. lepturus* and *H. maindroni*. Mature males in the material examined have been systematically dissected in order to remove and study their hemispermatophores. Several hemispermatophores in excellent shape of *H. lepturus*, *H. acanthocercus* and *H. maindroni* have been obtained. All of them bear a double lamellar hook, a very unusual feature that was so far only recorded for the liochelid genus *Hadogenes*. Unfortunately this character cannot be assessed for *H. enischnochela* sp. n., *H. persicus* and *H. socotranus*. The only available mature male of *H. enischnochela* had been dissected before but the hemispermatophore was not found inside the vial and is probably lost. We were not allowed to dissect the type of *H. persicus* and no other specimens of this species were available to us. The only available mature male of *H. socotranus* had poorly preserved paraxial organs from which it was impossible to extract hemispermatophores. Nevertheless the character "double lamellar hook" is used in our diagnosis of the family. In liochelids morphometric proportions of hemispermatophores and shape of the capsular median structure are usually the only features that vary between genera. The single lamellar hook is a constant character within the family, except for *Hadogenes*, species of which possess hemispermatophores with a double lamellar hook. According to Prendini (2000) *Hadogenes* and *Cheloctonus* are the more basal liochelid genera and Hemiscorpiidae is the basal sister-group of Liochelidae. The double lamellar hook can therefore be considered as a plesiomorphy for Hemiscorpiidae and Liochelidae, and the single lamellar hook is synapomorphic for Liochelidae except *Hadogenes*. Therefore the probability that the double lamellar hook is present in the whole Hemiscorpiidae is strong. Furthermore a double lamellar hook was assessed for hemiscorpiids from Oman by Dr. Graeme Lowe (pers. comm.) who is currently carrying out a revision of the scorpion fauna of Oman (Lowe, in prep.). This is another argument for including the double lamellar hook into the family diagnosis.

### *Hemiscorpius* Peters, 1861

*Hemiscorpius* Peters, 1861a: 426. Type species by monotypy *Hemiscorpius lepturus* Peters, 1861a.

*Habibiella* Vachon, 1974: 952, **syn. n.** Type species *Habibiella gaillardi* Vachon, 1974.

**Remarks.** Prendini (2000) suggested in his revision of the superfamily Scorpionoidea that *Habibiella* should be considered as a synonym of *Hemiscorpius*, because the monophyly of *Hemiscorpius* was not supported in any of his cladistic analyses. However, he did not formally propose this taxonomic change and listed both *Habibiella* and *Hemiscorpius* in the family Hemiscorpiidae. The genus *Habibiella* is monotypic and only known from a single female. It can be distinguished from *Hemiscorpius* only on the basis of its trichobotriotaxy, 15 external trichobothria on the pedipal patella instead of 13, and 10-12 ventral trichobothria on the pedipalp patella instead of 3. The study of a mature male from the Natural History Museum of Vienna that belongs to this genus and that is described here under *Hemiscorpius enischnochela* sp. n. allowed to re-evaluate the taxonomic status of *Habibiella*. Metasoma and telson of this specimen possess exactly the same morphology encountered in *Hemiscorpius lepturus*, i. e. extremely elongated metasoma, vesicle strongly elongated and bearing a

pair of blunt tuberculiform projections at the base of the short and strongly curved aculeus. The African and Arabian hemiscorpiids examined, i. e. *H. maindroni* and *H. socotranus*, do not have such features. Species of "*Habibiella*" are therefore more closely related to *Hemiscorpius lepturus*, the type species of *Hemiscorpius*, than *H. lepturus* is to the other *Hemiscorpius* species. *Habibiella* is therefore considered as a junior synonym of *Hemiscorpius*.

*Diagnosis.* With *Habibiella* now in synonymy with *Hemiscorpius*, the family Hemiscorpiidae becomes monotypic and its diagnosis is also applicable to the genus.

***Hemiscorpius acanthocercus* sp. n.**

Figs 1C-D, 2-7, 36

*Material examined.* Holotype: ♂, IRAN (Hormozgan), Abad-Geno, 38 km N Bandar Abbas, 3.IV.1972, K. Bilek, *NHMW* 4718 (39). Paratypes: 1 ♂, 1 ♀, no locality specified, H. Löffler, Austrian Iran Expedition 1949-1950, *MHNG*. 2 ♂ juv., 2 ♀ juv., no locality specified, H. Löffler, Austrian Iran Expedition 1949-1950, *NHMW*. 1 ♂ juv., IRAN (Hormozgan), ca. 50 km N Bandar Abbas, 4.IV.1970, F. Ressler, *NHMW* 3393. 1 ♂ juv., 1 ♀ juv., IRAN (Hormozgan), ca. 41 km N Bandar Abbas, 7.IV.1972, G. Pretzman & A. Konetschnig, *NHMW* 3394. 1 ♂ subadult, 2 ♂ juv., 2 ♀, 1 ♀ juv., IRAN (Hormozgan), 115 km E Bandar Abbas, 27.III.1972, K. Bilek, *NHMW* 4716. 1 ♂ juv., 1 ♀, IRAN (Hormozgan), 22 km N Bandar Abbas, 4.IV.1972, K. Bilek, *NHMW* 4717. 2 ♀ juv., same data as for holotype, *NHMW* 4718. 1 ♂ juv., 1 ♀, 1 ♀ juv., IRAN (Hormozgan), 40 km N Bandar Abbas, 7.IV.1972, K. Bilek, *NHMW* 4719. 1 ♂ subadult, IRAN (Hormozgan), 41 km N Bandar Abbas, 20.IV.1974, G. Pretzman, *NHMW* 4720. 1 ♂ subadult, 2 ♀, IRAN (Hormozgan), 65 km N Bandar Abbas, 30.III.1972, K. Bilek, *NHMW* 4721. 1 ♀ juv., IRAN (Hormozgan), 22 km N Bandar Abbas, 1974, G. Pretzman, *NHMW* 21142. 1 ♂ imm., 1 ♀, 1 ♀ juv., IRAN (Hormozgan), 38 km N Bandar Abbas, 28.III.1972, K. Bilek, *NHMW* 21143. 2 ♀, IRAN (Hormozgan), 65 km N Bandar Abbas, 4.IV.1972, K. Bilek, *NHMW* 21144.

*Distribution.* Known from the surroundings of Bandar Abbas, Hormozgan Province, eastern Iran (Fig. 36).

*Etymology.* The name *acanthocercus* is a construct from the Greek words *akantha* [thorn, prickle] and *kerkos* [tail]. The name is an invariable noun in apposition and refers to the metasomal dorsal carinae of males, which have numerous strong spiniform granules, and to the telson of males which also bears numerous small spiniform granules, especially at the posterior extremity, on the blunt tuberculiform processes at the base of the aculeus.

*Diagnosis.* (1) Carapace longer than wide, shagreened and finely granular, with small smooth patches; lateral margins with small spiniform granules below lateral ocular tubercles; superciliary carinae finely granular; (2) pedipalps stout and bulky, chela fingers slightly shorter than or equal in length to chela manus; (3) internal protuberance of pedipalpal patella with internodorsal carina bearing 1-2 strong spiniform granules; (4) pedipalp patella orthobothriotaxic, external side with 13 trichobotria (1 *est* and 2 *esb*), ventral side with 3 trichobotria; (5) metasoma of males elongated and slender, with dorsal carinae bearing numerous strong spiniform granules, and ventral and ventrolateral carinae of segments IV-V bearing spiniform granules; (6) telson of males strongly elongated, bearing a pair of blunt tuberculiform processes with small spiniform granules at base of aculeus; (7) metasoma of females with dorsal carinae of segments I-IV and ventral and ventrolateral carinae of segment V bearing strong spiniform granules; (8) hemispermatophore with strong double lamellar hook located above distal transverse ridge, very close to it, and pointing antieriad.



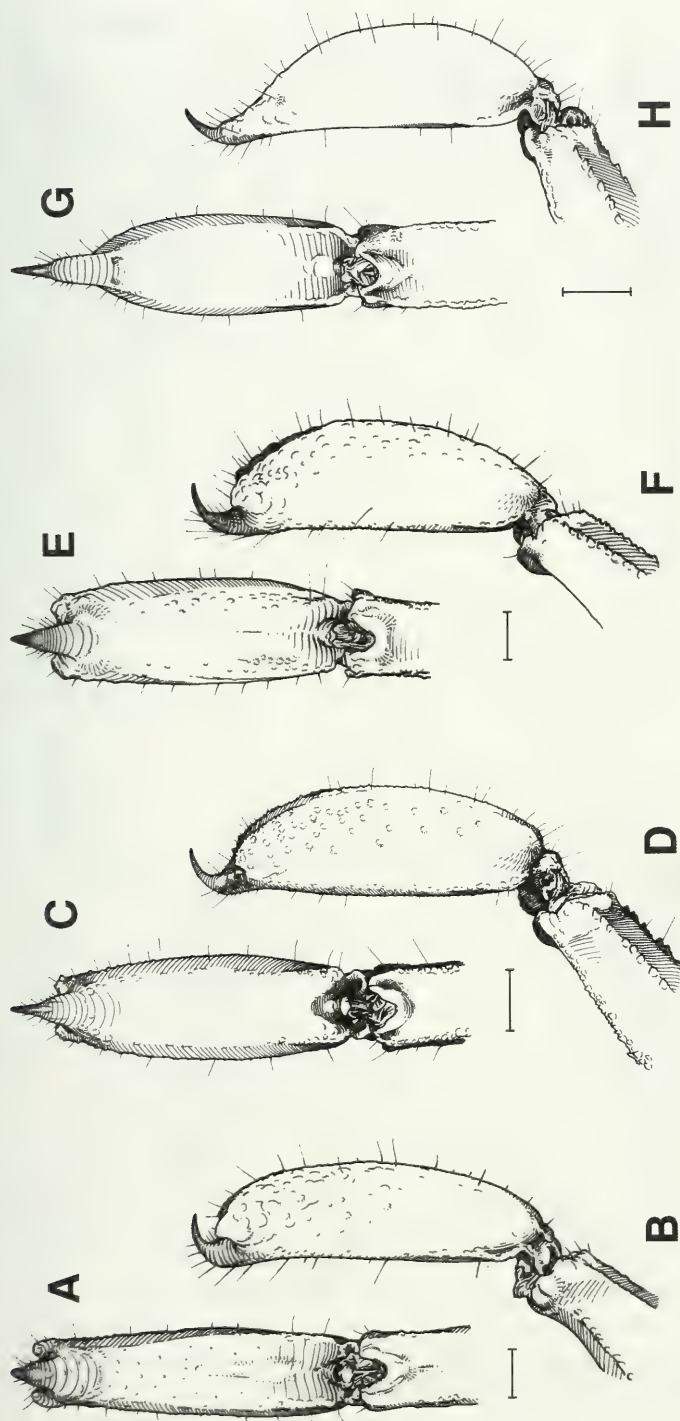


FIG. 1

*Hemiscorpius* spp., males: telsons, ventral face (A, C, E, G), lateral face (B, D, F, H). A-B, *Hemiscorpius lepturus* (MNHN-RS 5232); C-D, *Hemiscorpius acanthocercus* sp. n. (paratype, MHNG, H. Löffler coll.); E-F, *Hemiscorpius enischnochela* sp. n. (holotype); G-H, *Hemiscorpius maindroni*, (syntype, MNHN-RS 4328). Scale lines, 1 mm.

*H. acanthocercus* sp. n. is closely related to *H. lepturus*, both of them have stout orthobothriotaxic pedipalps and pronounced sexual dimorphism. However, males of these 2 species can be readily distinguished by (1) carapace granulation, (2) metasoma carination, (3) morphology of telson, (4) pedipalp carination and shape, and (5) hemispermatophore morphology. The carapace of *H. acanthocercus* sp. n. has lateral margins bearing small spiniform granules below the lateral eyes, while in *H. lepturus* the lateral carapace margins are completely smooth. *H. acanthocercus* sp. n. has metasomal dorsal carinae bearing numerous strong spiniform granules, while *H. lepturus* has carinae with sparse, much reduced and weaker spiniform granules, especially on the anterior segments. The ventral and ventrolateral carinae of metasomal segments IV-V are furnished with spiniform granules in males of *H. acanthocercus* sp. n., but are almost smooth, with weak spiniform granules (carinae of segment V with more marked spiniform granules in the posterior half) in *H. lepturus*. In *H. acanthocercus* sp. n. the telson of males is less elongated and the aculeus is less curved than in *H. lepturus*. The lateral surfaces of the telson are fairly smooth, with only small granules, and distal protuberances bear small spiniform granules in *H. acanthocercus*, while the lateral surfaces and distal projections are rugose, without distinct granules, in *H. lepturus*. Furthermore the distal telson projections are bigger in *H. lepturus*. The pedipalp chela manus in *H. acanthocercus* sp. n. is slightly thinner than in *H. lepturus*. *H. acanthocercus* sp. n. has intero-dorsal carina of the patellar prominence with a single strong spiniform granule (rarely 2), while *H. lepturus* has carinae with several much reduced, weaker granules. Females of these two species are very similar to each other, but can be distinguished by the superciliary carinae, which are very finely granular in *H. acanthocercus* sp. n., while smooth, or nearly so, in *H. lepturus*. Hemispermatophores of *H. acanthocercus* sp. n. possess a double lamellar hook that is stronger than in *H. lepturus*. The lamellar hook is located very close to the distal transverse ridge and points anteriorly in *H. acanthocercus* sp. n., while it is located more distally and points distally in *H. lepturus*.

**Description.** MALE (Figs 1C-D, 2A-B, 3A, 4B, 5A-C, E-F, 6A, 7) [description based on the holotype (NHMW 4718)]. Measurements of holotype (in mm) carapace, length 5.2; posterior width 4.9; distance between anterior lateral eyes 2.7, between posterior lateral eyes 3.2, between median eyes 0.2; diameter of median eyes 0.3. Pedipalp, femur length 5.0, width 1.8; patella length 5.0, width 1.7, chela length 9.7; manus length 5.0, width 3.8, depth 2.3; movable finger length 4.6; fixed finger length 3.6. Metasoma, segment I length 5.2, width 1.4; segment V length 7.4, width 1.2, depth 1.4; vesicle length 4.6, width 1.5, depth 1.8, aculeus length 0.9. Total length 60.0.

Carapace (Fig. 3A). Colouration mostly uniformly dark orange to brown; median and lateral ocular tubercles black. Carapace dorsoventrally flattened, longer than wide, almost rectangular in shape, with sides nearly parallel; median ocular tubercle weakly developed, low, distinctly situated anteriorly, with weak, finely granular superciliary carinae; frontal concavity or notch well-developed; anterior lobes truncate; lateral ocular tubercles with 3 ocelli, the posterior one smaller than the 2 anteriors. Carapace shagreened and finely granular, with a few smooth patches; lateral margins with small spiniform granules below lateral ocular tubercles; antero-median furrow narrow, suturiform, anteriorly bifurcated; median longitudinal furrow shallow, continuous from the anterior suture furcation, running through ocular tubercle posteriorly

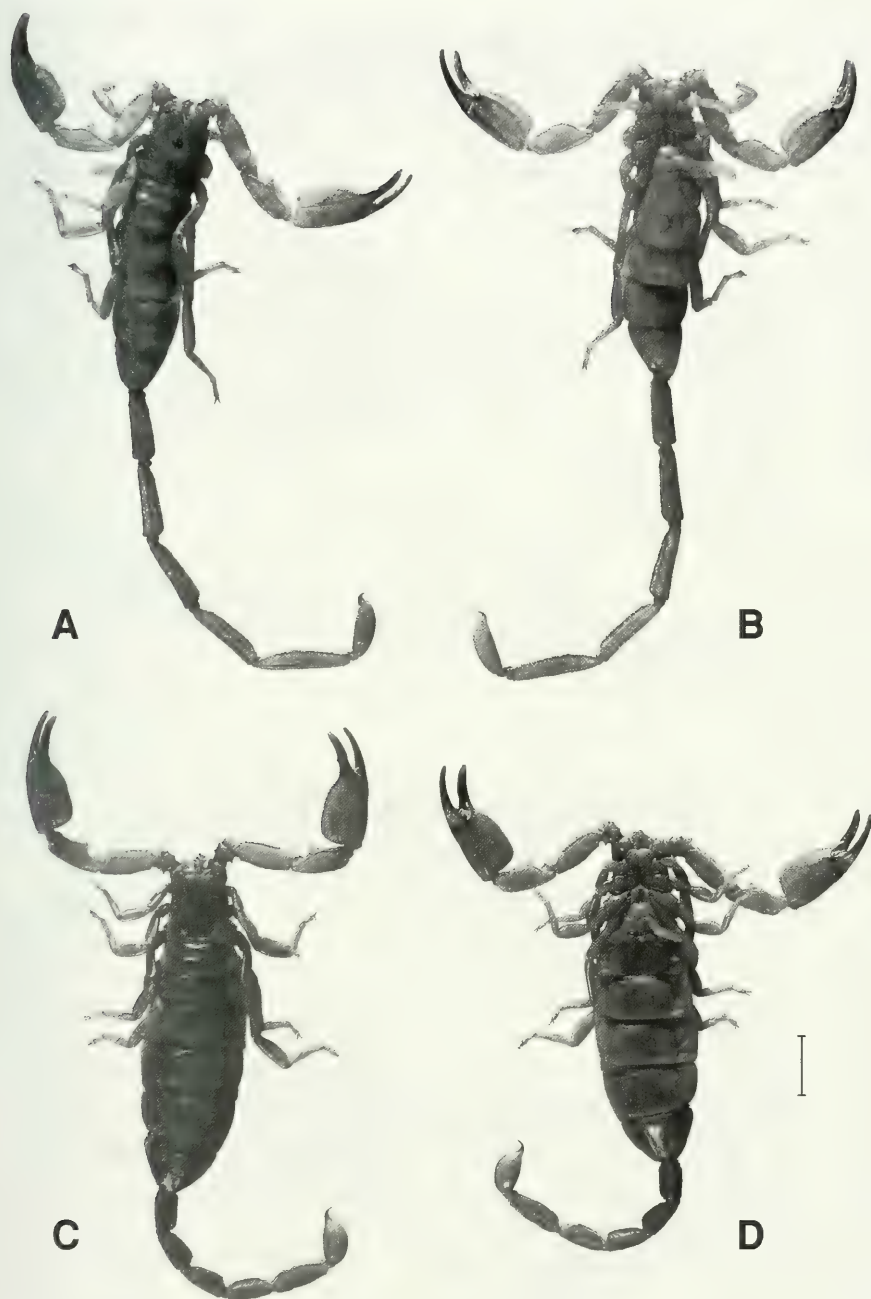


FIG. 2

*Hemiscorpius acanthocercus* sp. n. Male paratype (MHNG, H. Löffler coll.): A, dorsal aspect; B, ventral aspect. Female paratype (NHMW 4719): C, dorsal aspect; D, ventral aspect. Scale line, 5 mm.



into a deep triangular depression; postero-lateral furrow shallow; mesolateral furrow weakly developed, almost indiscernible.

**Mesosoma.** Tergite colouration dark orange to brown anteriorly, becoming lighter posteriorly (dark yellow). Tergites I-III with a shallow median depression divided anteriorly by a weak ridge; tergites IV-VII with median carina reduced to a very weak ridge surrounded by a pair of shallow, submedian depressions. Lateral and sublateral carinae absent on tergites I-VI, but present on the posterior 2/3 of tergite VII as ridges with weak spiniform granules. Surface of tergites shagreened and finely granular; pre-tergites smooth and minutely pitted. Sternite colouration dark yellow. Sternites III-VI smooth and minutely pitted, without granulation or carinae; sternite III with a pair of large, very finely and densely granular depressions, covered by the pectines; sternites IV-VI with a pair of shallow median furrows. Sternite VII with similar surface texture as on preceding sternites; pair of lateral carinae developed as ridges; median carinae absent. Spiracles of book lungs crescent-shaped. Tergites and sternites VII longer than wide.

**Metasoma** (Fig. 4B) very elongated and slender, shagreened, with very few small scattered granules. Colour dark yellow to orange. Segments I-IV with longitudinal dorsomedian furrow, dorsal carinae with strong spiniform granules. Segments I-IV with lateral carinae developed as weakly granular ridges, lateral carinae on segments III-IV less granular than those on segments I-II. Segments I-II with ventrolateral carinae as ridges with few weak granules, almost smooth; segments III-IV with ventrolateral carinae as ridges of reduced spiniform granules. Segment I: ventral carina indistinct, reduced to a weak ridge; segments II-III with ventral carina developed as a distinct ridge, almost smooth; segment IV with ventral carina as a ridge, anterior 1/3 smooth and posterior 2/3 with weak spiniform granules. Segment V: longitudinal dorsal furrow present in anterior half, dorsal carinae with strong spiniform granules; lateral carina indistinct, visible as a row of small granules in anterior 2/3 only; ventrolateral and ventromedian carinae with spiniform granules.

**Telson** (Figs 1C-D, 4B). Vesicle yellow to orange; aculeus darker, tan, due to stronger sclerotisation; vesicle elliptical or ovate, strongly elongated, with a blunt tuberculiform projection on each side at base of aculeus; ventrolateral furrows absent; ventromedian ridge absent; lateral surfaces smooth, with few weak granules; posterior projections with small spiniform granules; dorsal surface with numerous small spiniform granules and a median shallow depression. Few macrosetae basally, becoming more numerous near base of aculeus. Aculeus short and stout, strongly curved, becoming markedly narrower approximately midway.

**Chelicerae.** Colour dark yellow; teeth of fingers darker orange. Teeth arrangement as in Scorpionidae (see Vachon, 1963); fixed finger with median and basal teeth bifid; movable finger with one subdistal tooth and one basal tooth in external series; distal external tooth smaller than distal internal tooth; cheliceral teeth without secondary serrations.

**Pedipalp** stout and bulky. Pedipalp coxa and femur (Fig. 5A, E-F). Inter-ventral margin of coxa with strong spiniform granules. Dorsal surface of femur predominantly dark yellow-orange, carinae darker, orange. Femur stout (length less than 2.5 times its width), pentacarinata, with 4 distinct carinae; internodorsal carina

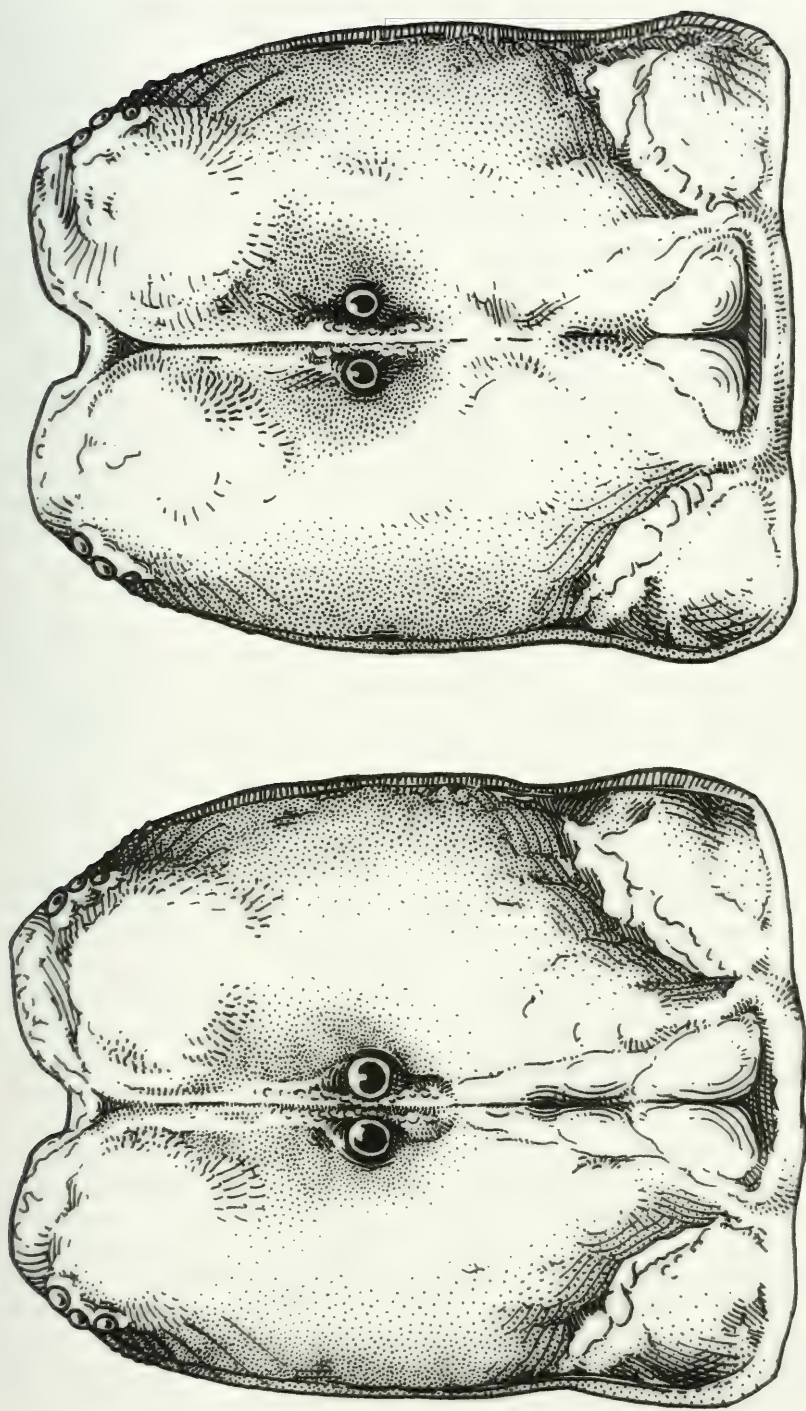


FIG. 3

*Hemiscorpius acanthocercus* sp. n., carapace, dorsal aspect: A, male holotype (NHMW 4718); B, female paratype (NHMW 4719). Scale line, 1 mm.

developed as a strongly and densely granular ridge, granules spiniform; externodorsal carina forming a ridge with spiniform granules; internoventral carina developed as a granular ridge with spiniform granules; externoventral carina developed as a ridge with strong spiniform granules; ventromedian carina reduced to few granules and confined to base of femur. Dorsal surface shagreened, finely and densely granular, distal end smooth, without granules; internal surface shagreened, with a few strong, scattered, spiniform granules; external surface shagreened; ventral surface shagreened and weakly granular, distal end without granules. A total of 3 trichobothria present on femur; *d* located externobasally on dorsal surface; *i* located dorsobasally on internal surface; *e* located dorsobasally on external surface. Pedipalp patella (Fig. 5A, E-F) stout and bulky (length less than 2.5 times its width). Colour predominantly dark yellow to orange; carinae slightly darker. 7 carinae present, 6 of them distinct; internodorsal carina developed as a granular ridge; externodorsal carina developed as a ridge of indistinct granules; internoventral carina developed as a granular ridge; externoventral carina developed as a ridge of weak granules; externomedian carina developed as a weakly granular ridge. Dorsal surface shagreened, sparsely and weakly granular; internal and external surfaces shagreened; ventral surface shagreened, sparsely and weakly granular, distal end without granules. Internal protuberance pronounced, bifid (internodorsal and internoventral tubercles separated), internodorsal carina with 1 spiniform granule. A total of 19 trichobothria present on patella, orthobothriotaxy; *d*<sub>1</sub> located basally, external to internodorsal carina; *d*<sub>2</sub> located midway on patella; *d*<sub>3</sub> absent; *i* in distal half of patella, located dorsally on internal surface. External (*e*) trichobothrial groups discernible and orthobothriotaxic: *eb* group composed of 5 trichobothria, *esb* group of 2 trichobothria, *em* group of 2 trichobothria, *et* group of 3 trichobothria; *est* very close to *et* group. Ventral (*v*) group orthobothriotaxic, 3 trichobothria. Pedipalp chela manus (Fig. 5A-C). Colour predominantly orange to red-brown; carinae darker red. Chela stout (length less than 2.5 times its width) with 5 distinct carinae; internodorsal carina continuous, with strong spiniform granules basally and weak granules distally; subdigital carina vestigial, visible basally as a smooth ridge with weak granules; externodorsal carina distinct, visible as a ridge of indistinct fused granules, almost smooth; digital carina a smooth ridge with few weak granules basally; dorsal secondary carina (dorsomedian) a smooth ridge with few strong granules basally and few weak granules distally; internoventral carina continuous, visible as a weak ridge with few weak spiniform granules distally; externoventral carina continuous, forming a granular ridge, becoming almost smooth distally, running parallel to longitudinal axis of chela, its distal edge disconnected from external movable finger condyle and directed between external and internal condyles of movable finger; ventromedian carina vestigial, reduced to few coarse granules basally; internal (internomedian) carina vestigial, reduced to few weak spiniform granules distally; external (externomedian) carina indistinct, visible as raised rows of small weak granules. Dorsal surface forming an irregular and subreticulate network of weakly granular ridges surrounding shagreened patches without granules; internal surface shagreened, sparsely granular, with a denser patch of spiniform granules dorsodistally; external surface shagreened, sparsely and weakly granular; ventral surface with few weak granules surrounding shagreened patches, distal end smooth and pitted. A total of 15 trichobothria present on chela; *Db* trichobothria located externobasally on dorsal surface; *Eb* group (3 tri-



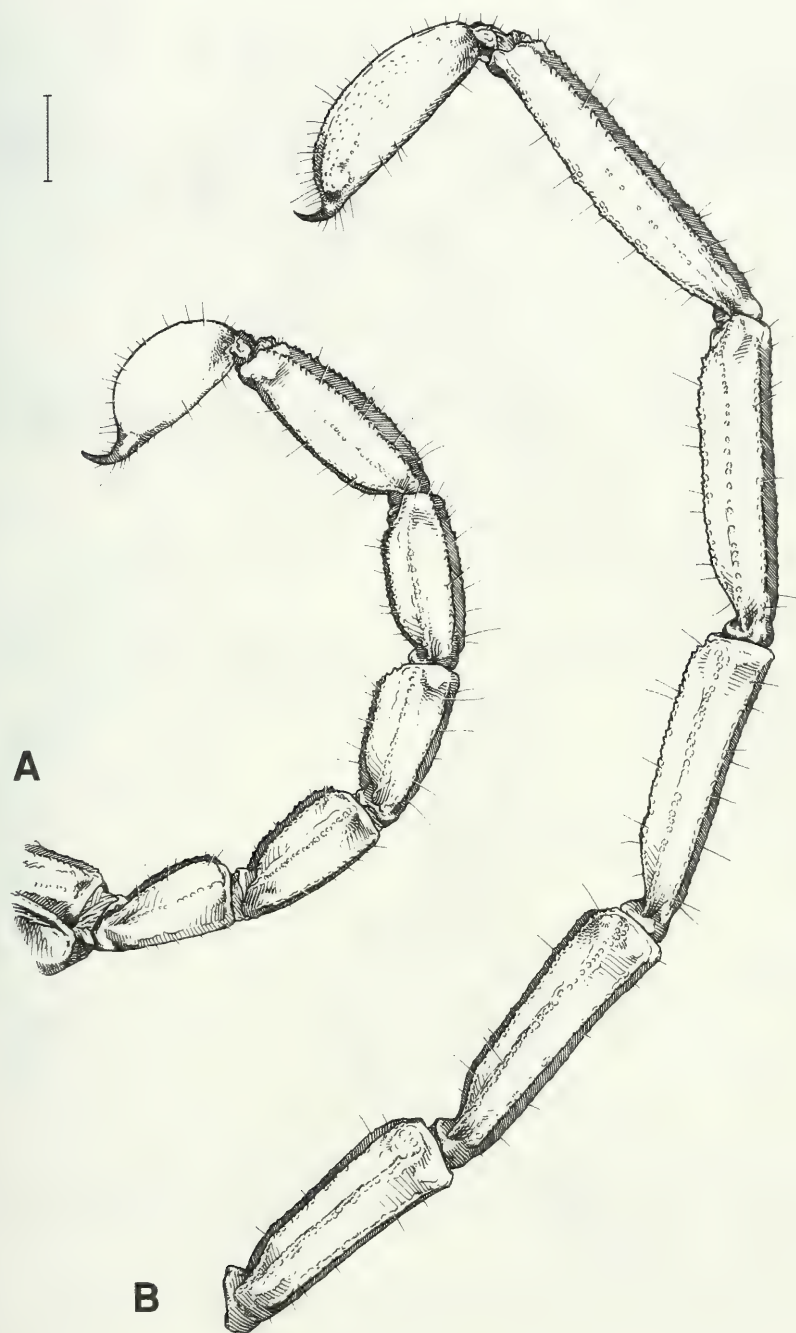


FIG. 4

*Hemiscorpius acanthocercus* sp. n., metasoma, lateral aspect: A, female paratype (NHMW 4717); B, male paratype (MHNG, H. Löffler coll.). Scale line, 2 mm.

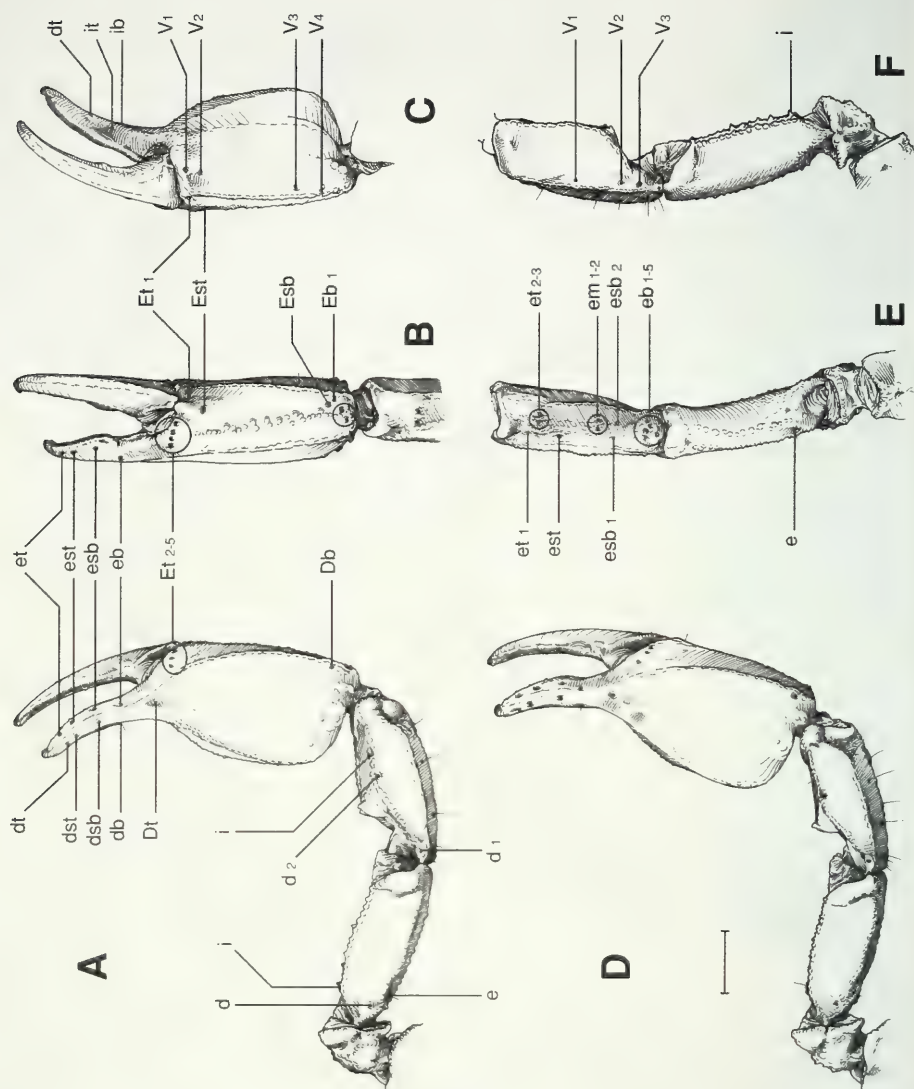


FIG. 5

*Hemiscorpius acanthocercus* sp. n. Male paratype (MHNG, H. Löffler coll.): A, pedipalp with trichobothrial pattern, dorsal aspect; B, chela, external aspect; C, idem, ventral aspect; E, femur and patella, external aspect; F, idem, ventral aspect. Female paratype (NHMW 4719): D, pedipalp, dorsal aspect. Scale line, 2 mm.

chobothria) orthobothriotaxic, located basally on external surface; *Esb* very close to *Eb* group; *Em* absent; *Est* located distally, very close to *Et* group; *Et* group composed of 5 trichobothria, *Et1* located ventrally; *V* group comprising 4 trichobothria, *V3* and *V4* located in basal half of manus, *V1* and *V2* located very distally. Fingers of pedipalpal chela (Fig. 5A-C). Basally reddish tan, becoming gradually lighter distally, tips of fin-

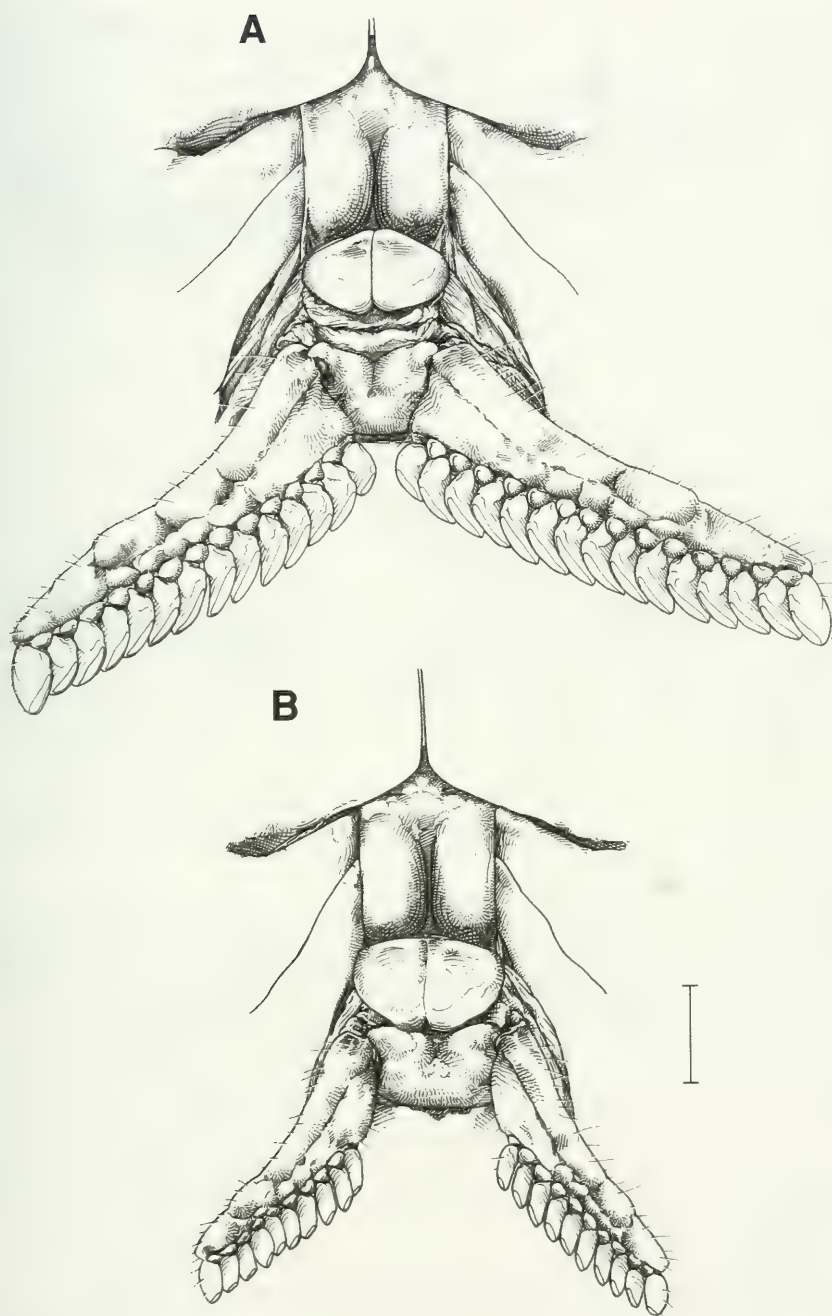


FIG. 6

*Hemiscorpius acanthocercus* sp. n., pectines and genital opercula, ventral aspect: A, male holotype; B, female paratype (NHMW 21143). Scale line, 1 mm.



gers lighter orange. Dorsal and ventral surfaces predominantly smooth and minutely pitted, slightly shagreened basally. Fingers slightly shorter than chelal manus. Fixed finger with weak basal concavity, movable finger with corresponding lobe weakly developed. Tips of fingers with pronounced terminal hook. Fingers with distal diastema; edges of fingers composed of 2 rows of denticles becoming fused basally, interrupted at regular intervals by stronger granules, each of these coupled with an accessory granule; rows fused into a single row above the concavity on the fixed finger and on notch of movable finger, single basal row running to base of fingers, in some males absent on movable finger. A total of 11 trichobothria present on fingers; *Dt* located very basally on dorsal surface; *db* located dorsally on internal surface, in basal half of fixed finger; *dsb*, *dsl* and *dt* on dorsal surface, in distal half of finger; *eb* located dorsally on external surface, in basal 1/3 of fixed finger, opposite *db*; *esh*, *est* and *et* in distal half of fixed finger, opposite *dsb*, *dsl* and *dt* respectively; *it* and *ib* located in median 1/3 of fixed finger.

Coxosternal sclerites. Dark yellow to orange; smooth and minutely pitted. Anterior margin of coxapophysis I with few weak granules, expanded but not sub-triangular in shape. Sternum of type 2 (Soleglad & Fet, 2003), longer than wide, pentagonal, slightly shagreened; median furrow deep, more pronounced in posterior half; posterior pit absent.

Legs. Pale yellow. Predominantly shagreened; ventral surface smooth; dorsal surfaces of trochanter and femur finely and weakly granular. Tarsus with a ventro-median row of microspinules and with 2 rows of rigid "spinoid" ventral macrosetae, tarsi I-II: prolateral row with 4/5 macrosetae, retrolateral row with 5/6 macrosetae; tarsi III-IV: prolateral row with 5/6 macrosetae, retrolateral row with 6 macrosetae; setae acuminate; tarsal claws of equal length.

Pectines and genital operculum (Fig. 6A). Colour dark yellow; genital operculum composed of 2 subtriangular plates; genital papillae short, not protruding from beneath operculum; pectines with 14/15 teeth.

Hemispermaphore (Fig. 7) lamelliform, with complex capsule; distal lamellum slender, basally curved, with a strong double hook pointing antero-distad and located very basally, flagellum more than 1.5 times longer than basal part; distal crest absent. Double lamellar hook (*Dh*) located very slightly above distal transverse ridge (*Tr*); distal transverse ridge costate, distally strongly curved towards anterior margin, continuous from posterior to anterior margins, almost merging with lamellar hook, reaching anterior margin of distal lamella slightly below its hook. Capsule lamella (*La*) broad, with a deep longitudinal furrow, forming an acute angle with longitudinal axis of capsule, bearing a strong hook on its external surface and an accessory lobe (*Lac*) on its posterior margin; ventral margin straight. Distal lobe (*Ld*) forming a strong hook pointing antiad; basal margin straight. Basal lobe (*Lb*) strongly reduced. Posterior lamella (*Lp*) costate.

FEMALE (Figs 2C-D, 3B, 4A, 5D, 6B). Measurements of paratype (NHMW 4719). Carapace, length 5.9, posterior width 5.0; distance between anterior lateral eyes 3.1, between posterior lateral eyes 3.6, between median eyes 0.2; diameter of median eyes 0.2. Pedipalp, femur length 5.0, width 1.9; patella length 5.2, width 1.8, chela length 10.1; manus length 5.2, width 4.0, depth 2.7; movable finger length 5.2; fixed finger length 3.9. Metasoma, segment I length 3.3, width 1.9; segment V length 5.1,

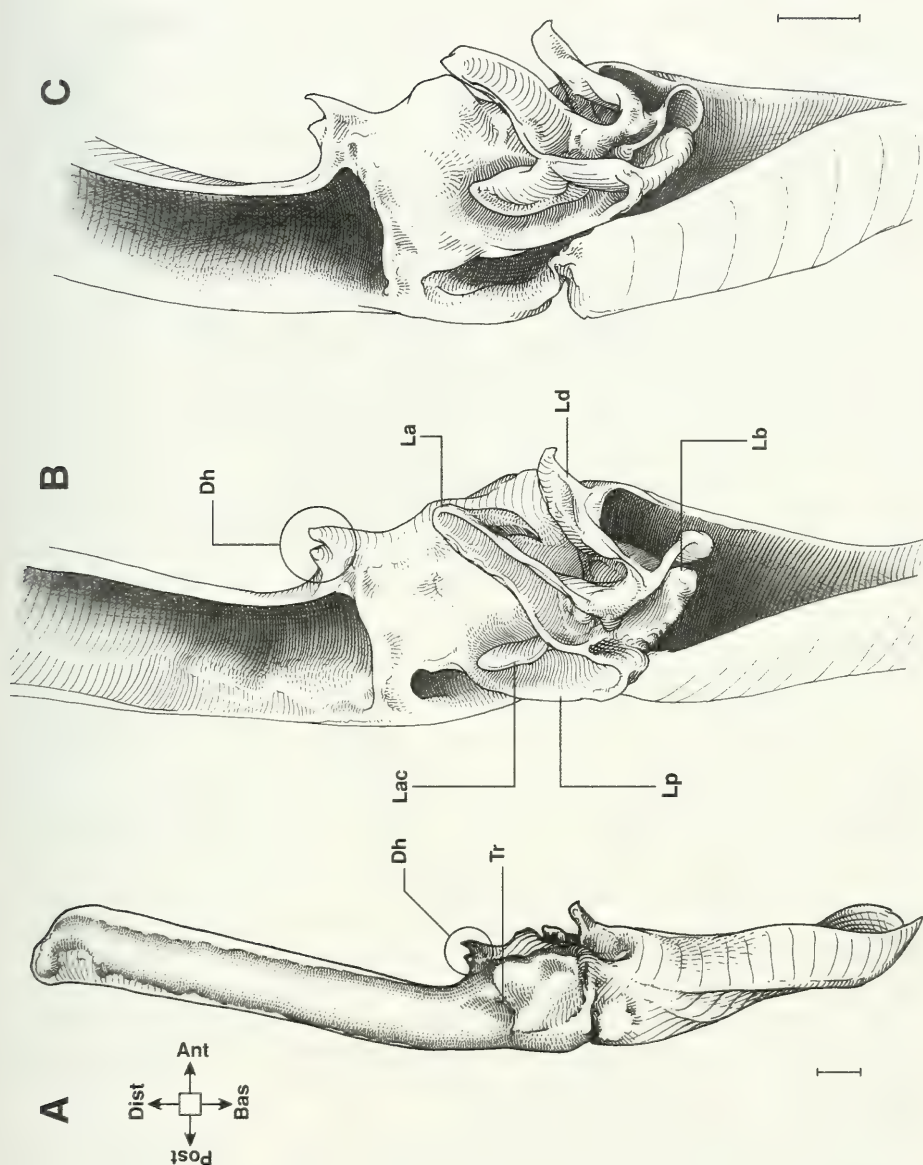


FIG. 7

*Hemiscorpius acanthocercus* sp. n., male holotype, hemispermatophore: A, whole hemispermatophore, arrows indicating its post-extrusion orientation, Ant (anterior), Bas (basal), Dist (distal), Post (posterior), Tr (transverse ridge); B-C, detail of the capsular region, internal aspect, Dh (double hook), La (lamella), Lac (accessory lobe), Lb (basal lobe), Ld (distal lobe), Lp (posterior lobe). Scale lines, 0.25 mm.

width 1.4, depth 1.7; vesicle length 3.7, width 2.0, depth 2.1, aculeus length 1.2. Total length 53.0.

Same characters as in males, except as follows. Carapace (Fig. 3B) shagreened and finely granular, each anterior lobe with a smooth, shiny and minutely pitted median area between median and lateral ocular tubercles; median longitudinal furrow shallow, continuous from the anterior suture furcation, ending after the median ocular tubercle and not running posteriorly into a deep triangular depression. Mesosoma. Median carina absent from tergites I-III. Surface of tergites smooth, shiny; median area finely granular; median carina on tergites IV-IV smooth and pitted posteriorly. Sternites III-VI smooth, without granulation or carinae. Sternite VII smooth, with a pair of median carinae developed as very weak ridges, almost indiscernible. Tergites and sternites VII as long as wide. Metasoma (Fig. 4A). Short and stout, shagreened, without granules. Segments I-II with ventrolateral carinae forming almost smooth ridges. Segment I without ventral carina; segments II with ventral carina developed as a ridge, smooth in anterior half, with weak granules in posterior half; segment III with ventral carina forming a ridge of weak granules; segment IV with ventral carina developed as a ridge of weak spiniform granules. Segment V: dorsal carinae with spiniform granules; lateral carina vestigial, barely visible in anterior 2/3, composed of few very weak scattered granules; ventromedian carina with strong spiniform granules. Telson (Fig. 4A). Vesicle globular, very bulky; lateral surfaces smooth, with few extremely weak granules (almost indistinct); dorsal surface smooth, median shallow depression indistinct, only visible anteriorly. Aculeus without tubercles at its base, narrowing slightly less marked than in male. Pedipalp patella (Fig. 5D). Internal protuberance with internodorsal carina carrying 1-2 spiniform granules, less developed than in male. Pedipalpal chela (Fig. 5D) slightly more bulky than in male, chela fingers equal in length to chela manus or slightly shorter. Carinae of chelal manus generally less granular and less distinct than in males. Interno-dorsal carina vestigial, basally visible as few strong spiniform granules; subdigital carina vestigial; externodorsal carina distinct, visible as a smooth ridge; digital carina developed as a weak ridge with few weak granules basally; dorsal secondary carina (dorsomedian) forming a weak, smooth ridge with 1-2 strong granules basally; internoventral carina continuous, visible as a weak ridge with few weak granules distally; externoventral carina continuous, a ridge of indistinct granules, becoming almost smooth distally. Ventral surface smooth and pitted with shagreened patches. Pectines and genital operculum (Fig. 6B). Genital operculum composed of a single posteriorly truncated subtriangular plate with a median longitudinal furrow and a relatively deep posterior notch; pectines with 10/10 teeth.

*Intraspecific variation.* Females have pectines with 8 to 11 teeth, usually 9/9 or 10/10, males have pectines with 13 to 16 teeth, usually 14/14 or 15/15. Juveniles (males and females) have slender pedipalps, which are morphologically similar to the pedipalps of mature males. Juveniles and subadult males do not possess an extremely elongated metasoma, they apparently acquire this feature only in the last developmental stage.

***Hemiscorpius enischnochela* sp. n.**

Figs 1E-F, 8-12, 26A-B, 27 C-D, 36

*Material examined.* Holotype: ♂, IRAN (Hormozgan), ca. 115 km E Bandar Abbas, VII.1974, G. Pretzman, *NHMW* (52). Paratypes: 2 ♀, IRAN (Khuzestan), S of Masdjed-e-





FIG. 8

*Hemiscorpius enischnochela* sp. n. Male holotype: dorsal aspect. Scale line, 5 mm.

Soleyman, I.1970, R. Farzanpay ?, *MHNG* (SF 0057-1/2). 1 ♀ juv., same data as for holotype, *NHMW* (53). 1 ♀ subadult, IRAN (Hormozgan), 38 km N Bandar Abbas, 28.III.1972, K. Bilek, *NHMW* (54). 1 ♀ juv., IRAN (Hormozgan), 38 km N Bandar Abbas, 28.III.1972, K. Bilek, *NHMW* (58). 1 ♀ juv., IRAN (Hormozgan), 22 km N Bandar Abbas, VII.1974, G. Pretzman ?, *NHMW* (60). 1 ♀ juv., IRAN (Hormozgan), 65 km N Bandar Abbas, 4.IV.1972, K. Bilek,

*NHMW* (64). 1 ♂ juv., IRAN (Hormozgan), 65 km N Bandar Abbas, 4.IV.1972, K. Bilek, *NHMW* (67). 1 ♀, IRAN (Hormozgan), Kol River bridge on a road near Lar, 32 km W Bandar Abbas, 1972, K. Bilek, *NHMW* (76). 2 ♂ subadults, IRAN (Hormozgan), Bandar Abbas, VI.1972, G. Pretzman, *NHMW* (80-81). 1 ♀ juv., IRAN (Hormozgan), ca. 41 km N Bandar Abbas, 7.IV.1972, G. Pretzman & A. Konetschnig, *NHMW* 3395.

*Distribution.* Known from surroundings of Bandar Abbas, Hormozgan Province, eastern Iran; S of Masdjed-e-Soleyman, Khuzestan Province (doubtful record, see below) (Fig. 36).

*Remark.* The species occurs around Bandar-Abbas in Eastern Iran. Among the material studied by Vachon, there was a female found far from this area, near Masdjed-e-Soleyman. There was no indication about the collector, who could possibly be R. Farzanpay. Since much information about Vachon's material was lost and mixed up after his death, it could be a case of mislabelling.

*Etymology.* The name *enischnochela* is a construct from the Greek words *enischnos* [slender, thin] and *chele* [claw]. The name is an invariable noun in apposition and refers to the pedipalp chela, which is slender and with long fingers.

*Diagnosis.* (1) Carapace longer than wide, shagreened and sparsely granular, with coarse granules on anterior margin between lateral ocular tubercles; lateral margins finely granular, especially below lateral ocular tubercles; superciliary carinae weak and finely granular; (2) pedipalps elongated, chela fingers slightly longer than chela manus; (3) internal protuberance of pedipalp patella with internodorsal carina bearing 3-4 strong spiniform granules; (4) pedipalp patella neobothriotaxic, external side with 14 trichobotria (1 *est* and 3 *esb*), ventral side with 10-12 trichobotria; (5) males with elongated and slender metasoma, with dorsal carinae of segments I-V and ventral and ventrolateral carinae of segments IV-V bearing small spiniform granules; (7) telson strongly elongated, bearing a pair of blunt tuberculiform processes at base of aculeus, surface irregular, rugose, without distinct granules; (8) metasoma of females with dorsal carinae of segments I-IV and ventral and ventrolateral carinae of segments IV-V bearing spiniform granules.

*H. enischnochela* sp. n. is closely related to *H. gaillardi*, both of them have elongated neobothriotaxic pedipalps. They can be readily distinguished by (1) their trichotriotaxy (*H. gaillardi* has an additional *est* trichobotry on the external face of the patella) and by (2) their pedipalp carination (*H. enischnochela* sp. n. has patellar processes with intero-dorsal carinae bearing 3 strong spiniform granules, while *H. gaillardi* has patellar processes with carinae bearing 6 spiniform granules, which are slightly smaller than those in *H. enischnochela* sp. n.).

*Description.* MALE (Figs 1E-F, 8, 10A-C, E-F, 11A, 12, 26A, 27D) [description based on the holotype (*NHMW* 52)]. Measurements of holotype (in mm). Carapace, length 7.6; posterior width 7.0; distance between anterior lateral eyes 4.0, between posterior lateral eyes 4.9, between median eyes 0.2; diameter of median eyes 0.2. Pedipalp, femur length 8.8, width 2.7; patella length 8.6, width 2.6, chela length 15.2; manus length 7.4, width 4.6, depth 3.2; movable finger length 8.2; fixed finger length 7.2. Metasoma, segment I length 9.6, width 2.5; segment V length 12.3, width 1.6, depth 2.0; vesicle length 7.4, width 2.3, depth 1.9, aculeus length 1.0. Total length 93.0.

Carapace (Fig. 26A). Colouration mostly uniformly dark yellow to orange; median and lateral ocular tubercle black. Carapace dorsoventrally flattened, longer than

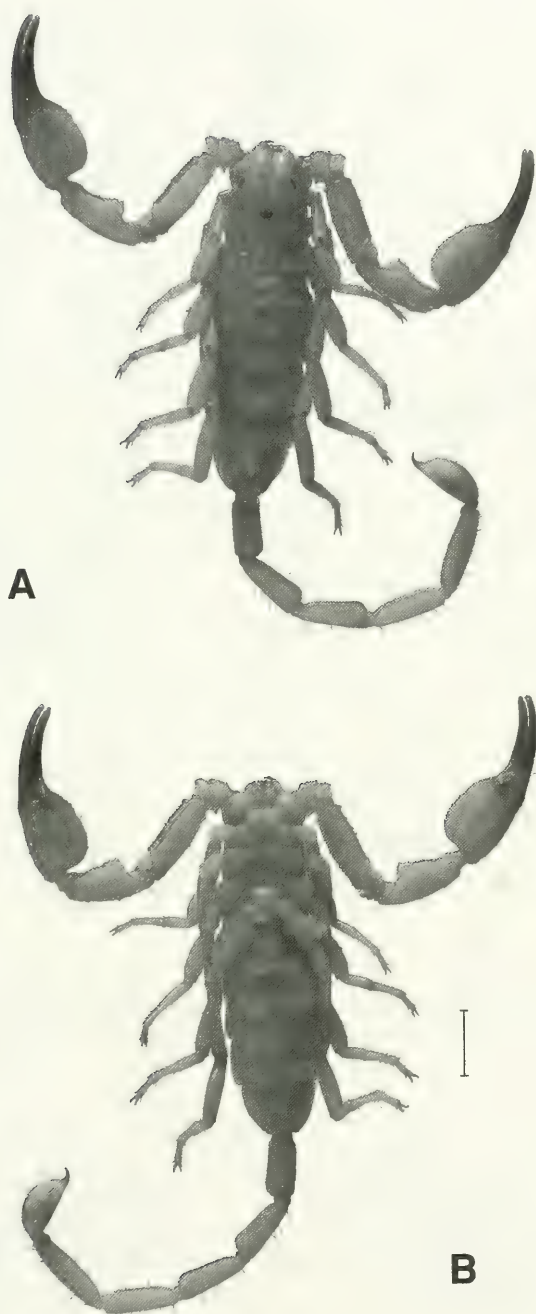


FIG. 9

*Hemiscorpius enischnochela* sp. n. Female paratype (NHMW 76, Kol River): A, dorsal aspect; B, ventral aspect. Scale line, 5 mm.



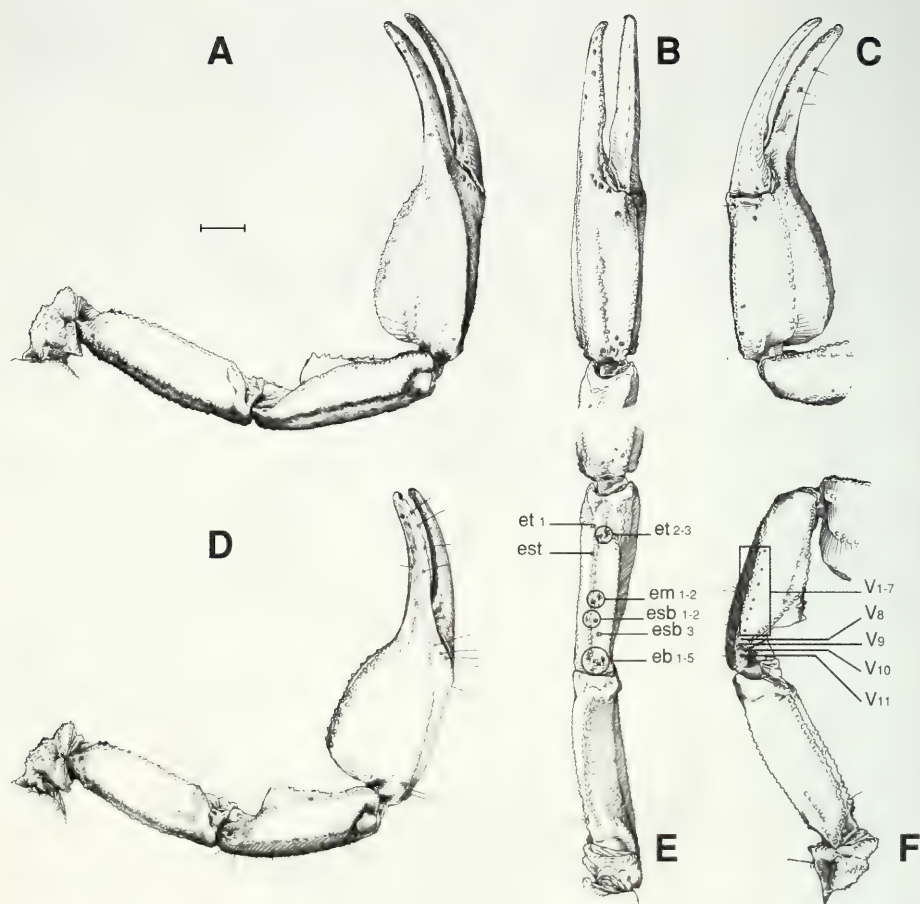


FIG. 10

*Hemiscorpius enischnochela* sp. n. Male holotype: A, pedipalp with trichobothrial pattern, dorsal aspect; B, chela, external aspect; C, idem, ventral aspect; E, femur and patella, external aspect; F, idem, ventral aspect. Female paratype (MHNG, Masdjed-e-Soleyman): D, pedipalp, dorsal aspect. Scale line, 2 mm.

wide, almost rectangular in shape, with sides nearly parallel; median ocular tubercle weakly developed, low, distinctly situated anteriorly, with weak, finely granular superciliary carinae; frontal concavity or notch well-developed; anterior lobes truncate; lateral ocular tubercles with 3 ocelli, the posterior one smaller than the 2 anteriors. Carapace shagreened, with sparse granules; stronger granules on the anterior margin between lateral ocular tubercles; edges granular, with stronger spiniform granules below lateral ocular tubercles; anteromedian furrow narrow, suturiform, anteriorly bifurcated; median longitudinal furrow shallow, continuous from the anterior suture furcation, running through ocular tubercle posteriorly into a deep triangular depression; postrolateral furrow shallow; mesolateral furrow weakly developed, almost indiscernible.

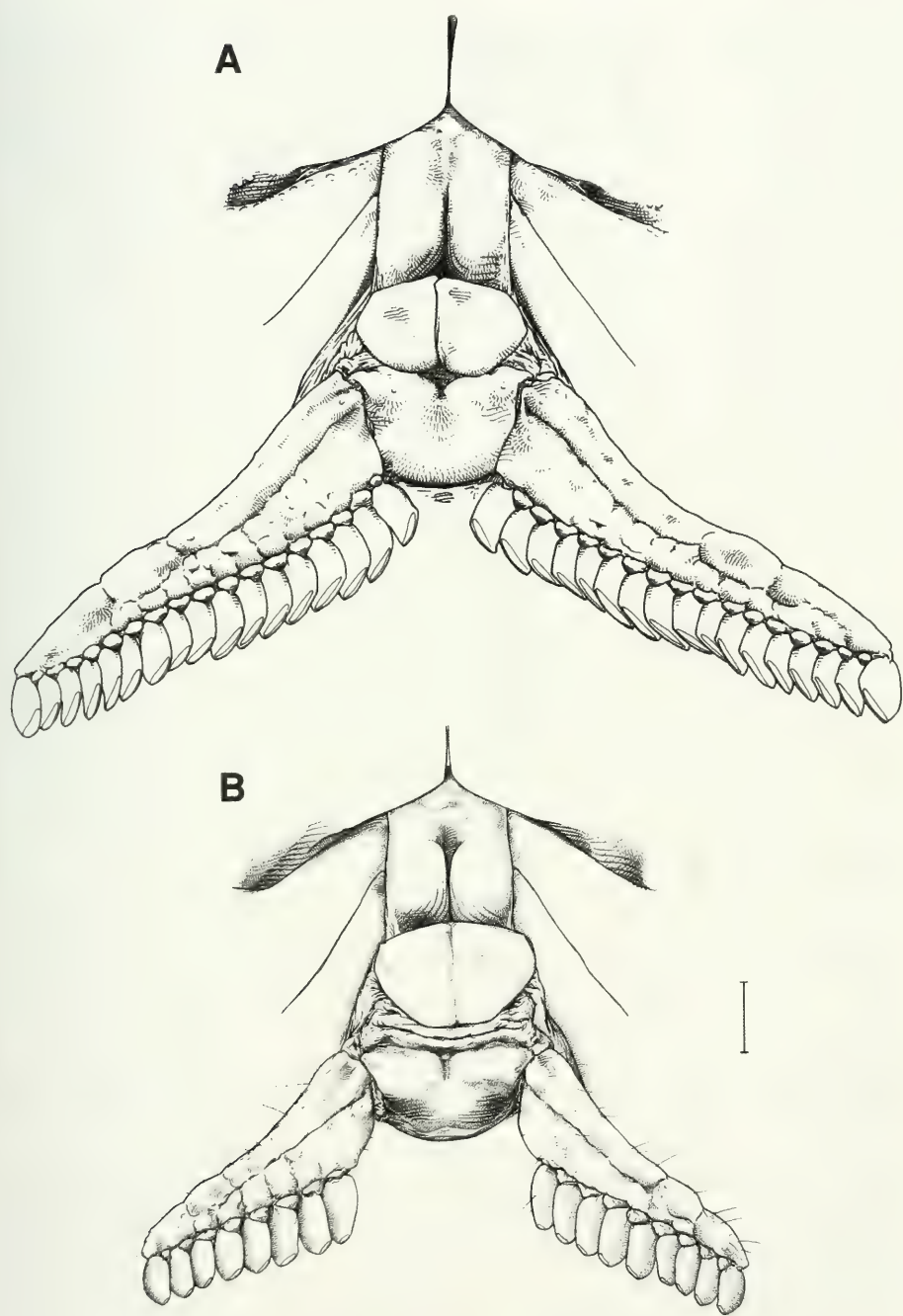


FIG. 11

*Hemiscorpius enischnochela* sp. n., pectines and genital opercula, ventral aspect: A, male holotype; B, female paratype (MHNG, Masdjed-e-Soleyman). Scale line, 1 mm.

Mesosoma. Tergite colouration dark orange to brown, becoming lighter posteriorly (dark yellow), tergite VII with a larger yellow posterior zone than on other tergites. Tergites I-III with a shallow median depression divided anteriorly by a weak ridge, tergites IV-VII with median carina reduced to a weak non-granular ridge surrounded by a pair of shallow, submedian depressions. Lateral and sublateral carinae absent on tergites I-VI, but present on posterior 2/3 of tergite VII, visible as strong ridges with spiniform granules. Surface of tergites shagreened, with scattered granules; pretergites smooth, shiny and minutely pitted. Sternite colouration pale yellow. Sternites III-VI smooth, shiny and minutely pitted, without granulation or carinae; sternite III with a pair of large, very finely and densely granular depressions, covered by the pectines; sternites IV-VI with a pair of shallow median furrows. Sternite VII with similar surface texture as on preceding sternites; a pair of lateral, slightly granular carinae present; median carinae absent. Spiracles of book lungs crescent-shaped. Tergites and sternites VII longer than wide.

Metasoma (Fig. 27D). Very elongated and slender, shagreened, with scattered granules. Colour dark yellow to orange. Segments I-IV with longitudinal dorsomedian furrow and with dorsal carinae composed of spiniform granules. Segments I-II with lateral carinae developed as granular ridges; segments III-IV with lateral carinae as ridges of indistinct fused granules, almost smooth. Segments I-II with ventrolateral carinae as granular ridges; segments III-IV with ventrolateral carinae as ridges of reduced spiniform granules. Segment I: ventral carina almost absent, reduced to a weak ridge; segments II-III with ventral carina forming a ridge of fused granules, almost smooth; segment IV with ventral carina forming a ridge of fused granules, almost smooth in the anterior half, and with more defined spiniform granules posteriorly. Segment V: longitudinal dorsal furrow present in anterior half, dorsal carinae with reduced spiniform granules; lateral carina indistinct, only visible in anterior half as a ridge of fused granules; ventrolateral carinae with reduced spiniform granules; ventromedian carina with spiniform granules.

Telson (Fig. 1E-F, 27D). Vesicle orange; aculeus darker, tan, due to stronger sclerotisation; vesicle elliptical or ovate, strongly elongated, with a blunt tuberculiform projection on each side at base of aculeus; ventrolateral furrows absent; ventromedian ridge absent; lateral surfaces rugose, irregular, with scattered weak granules; dorsal surface with numerous small spiniform granules and a median shallow depression. Macrosetae very sparse basally, becoming more numerous near base of aculeus. Aculeus short and stout, strongly curved, becoming markedly narrower approximately midway.

Chelicerae. Colour pale yellow; teeth of fingers darker orange. Teeth arrangement as in Scorpionidae (see Vachon, 1963); fixed finger with median and basal teeth bifid; movable finger with one subdistal tooth and one basal tooth in external series; distal external tooth smaller than distal internal tooth; cheliceral teeth without secondary serrations.

Pedipalp slender and elongated. Pedipalp coxa and femur (Fig. 10A, E-F). Internoventral margin of coxa with strong spiniform granules. Dorsal surface of femur predominantly dark yellow-orange, internodorsal, internoventral and externoventral carinae darker orange. Femur slender, elongate (equal to or longer than 3 times its



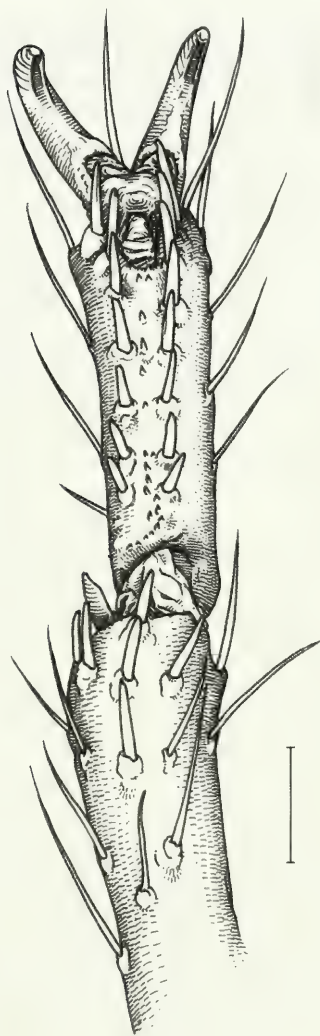


FIG. 12

*Hemiscorpius enischnochela* sp. n., male holotype: left tarsus IV, ventral aspect. Scale line, 0.5 mm.

width), pentacarinata, with 4 distinct carinae; internodorsal carina developed as a strongly and densely granular ridge, granules spiniform; externodorsal carina a strong granular ridge; internoventral carina developed as a granular ridge with spiniform granules; externoventral carina developed as a ridge with strong spiniform granules; ventromedian carina reduced to few granules and confined to base of femur. Dorsal surface shagreened, finely and densely granular, distal end smooth, without granules; internal surface shagreened, with few strong scattered spiniform granules; external surface shagreened; ventral surface shagreened and sparsely granular, distal end without

granules. A total of 3 trichobothria present on femur; *d* located externobasally on dorsal surface; *i* located dorsobasally on internal surface; *e* located dorsobasally on external surface. Pedipalp patella (Figs 10A, E-F) slender (length less than 2.5 times its width). Colour predominantly dark yellow to orange; carinae slightly darker. 7 carinae present, 6 of them distinct; internodorsal carina developed as a ridge of coarse granules; externodorsal carina forming a ridge of indistinct coarse granules; internoventral carina developed as a strongly granular ridge (spiniform granules); externoventral carina as a ridge of weak granules; externomedian carina as a granular ridge. Dorsal and internal surfaces shagreened, sparsely and weakly granular; external surface shagreened, with a few scattered granules; ventral surface shagreened, sparsely and weakly granular, distal end without granules. Internal protuberance pronounced, bifid (internodorsal and internoventral tubercles separated), internodorsal carina with 3-4 strong spiniform granules. A total of 28 trichobothria present on patella, neobothriotaxy major; *d*<sub>1</sub> located basally, external to internodorsal carina; *d*<sub>2</sub> situated in distal half of patella; *d*<sub>3</sub> absent; *i* in distal half of patella, located dorsally on internal surface. External (*e*) trichobothrial groups discernible and neobothriotaxic major: *eb* group composed of 5 trichobothria, *esb* group of 3 trichobothria, *em* group of 2 trichobothria, *et* group of 3 trichobothria; *est* very close to *et* group. Ventral (*v*) group neobothriotaxic, 11 trichobothria. Pedipalp chela manus (Figs 10A-C). Colour predominantly orange to red-brown; carinae darker red. Chela slender (length more than 3 times its width), with 5 distinct carinae; internodorsal carina continuous, with spiniform granules; subdigital carina vestigial, visible basally as a smooth ridge with weak granules; externodorsal carina distinct, visible as a ridge of indistinct fused granules, almost smooth; digital carina a smooth ridge with few weak granules basally; dorsal secondary carina (dorsomedian) a smooth ridge with few strong granules basally and few weak granules distally; internoventral carina continuous, visible as a weak ridge with few spiniform granules; externoventral carina continuous, forming a granular ridge, becoming almost smooth distally, running parallel to longitudinal axis of chela, its distal edge disconnected from external movable finger condyle and directed between external and internal condyles of movable finger; ventromedian carina vestigial, reduced to few coarse granules basally; internal (internomedian) carina visible as a weak ridge with few spiniform granules; external (externomedian) carina hardly discernible, visible as raised rows of small indistinct granules. Dorsal surface shagreened, sparsely and weakly granular; internal surface shagreened, sparsely granular, with a denser patch of spiniform granules dorsodistally; external surface shagreened, sparsely and weakly granular; ventral surface shagreened, sparsely and weakly granular, distal end without granules. A total of 15 trichobothria present on chelal manus; *Db* trichobothria situated externobasally on dorsal surface; *Eb* group (3 trichobothria) orthobothriotaxic, located basally on external surface; *Esb* very close to *Eb* group; *Em* absent; *Est* located distally, very close to *Et* group; *Et* group composed of 5 trichobothria, *Et*<sub>1</sub> located ventrally; *V* group comprising 4 trichobothria, *V3* and *V4* situated in basal third of manus, *V1* and *V2* located in distal quarter. Pedipalp chela fingers (Figs 10A-C). Basally reddish tan, becoming gradually lighter distally, tips of fingers yellow. Dorsal and ventral surfaces predominantly smooth, slightly shagreened basally. Fingers longer than chela manus. Fixed finger with a weak basal concavity, movable

finger with corresponding lobe weakly developed. Tips of fingers with pronounced distal hook. Fingers with distal diastema; edges of fingers composed of 2 rows of denticles becoming fused basally, interrupted at regular intervals by stronger granules, each of them coupled with an accessory granule; rows fused into a single row above concavity on fixed finger and on notch of movable finger, single basal row running towards base of fingers. A total of 11 trichobothria present on fingers; *Dt* located on dorsal surface, in basal third of fixed finger; *db* located dorsally on internal surface, approximately midway on fixed finger; *dsb*, *dst* and *dt* on dorsal surface, in distal half of finger; *eb* located dorsally on external surface, approximately midway on fixed finger, opposite *db*; *esb*, *est* and *et* in distal half of fixed finger; *esb* and *et* opposite *dsb* and *dt*, respectively; *it* and *ib* located in distal half of fixed finger.

Coxosternal sclerites. Dark yellow to orange, smooth and minutely pitted. Anterior margin of coxapophysis I with few weak granules, expanded but not sub-triangular in shape. Sternum of type 2 (Soleglad & Fet, 2003), longer than wide, pentagonal, shagreened; median furrow deep, more pronounced in posterior half; posterior pit absent.

Legs. Pale yellow. Predominantly shagreened; ventral surface smooth; dorsal surfaces of trochanter and femur finely granular. Tarsus (Fig. 12) with a ventromedian row of microspinules and with 2 rows of rigid "spinoid" ventral macrosetae; tarsi I-II: prolateral row with 5 or 6 macrosetae, retrolateral row with 7 macrosetae; tarsi III-IV: prolateral row with 7 macrosetae, retrolateral row with 7/8 macrosetae; setae acuminate; tarsal claws of equal length.

Pectines and genital operculum (Fig. 11A). Colour pale yellow; genital operculum composed of 2 ovoid plates; genital papillae short, not protruding from beneath operculum; pectines with 17/17 teeth.

Hemispermaphore. Unknown. The specimen was already dissected and the hemispermaphores were probably lost.

FEMALE (Figs 9, 10D, 11B, 26B, 27C). Measurements of paratype (MNHN Masdjed-e Soleyman). Carapace, length 7.4, posterior width 7.0; distance between anterior lateral eyes 4.0, between posterior lateral eyes 4.7, between median eyes 0.2; diameter of median eyes 0.2. Pedipalp, femur length 7.5, width 2.4; patella length 7.2, width 2.6, chela length 13.6; manus length 6.8, width 4.6, depth 3.3; movable finger length 6.9; fixed finger length 6.2. Metasoma, segment I length 4.8, width 2.2; segment V length 6.9, width 1.6, depth 2.0; vesicle length 5.2, width 2.8, depth 2.7, aculeus length 1.3. Total length 64.0.

Same characters as in males, except as follows. Carapace (Fig. 26B) shagreened and sparsely granular, each anterior lobe with a reduced central smooth area between median and lateral ocular tubercles. Mesosoma. Surface of tergites shagreened, with few smooth and pitted patches and scattered granules. Tergites and sternites VII almost as long as wide. Metasoma (Fig. 27C). Short and stout. Segments I-II with ventral carina developed as a smooth ridge; segments III with ventral carina as a ridge of weak spiniform granules; segment IV with ventral carina as a ridge of spiniform granules. Segment V: lateral carina indistinct; ventromedian carina with spiniform granules. Telson (Fig. 27C). Vesicle elliptical or ovate, short and bulky; lateral surfaces smooth and irregular; dorsal surface smooth and irregular, with a shallow median depression



posteriorly. Aculeus without tubercles at its base, narrowing slightly less marked than in male. Pedipalp coxa and femur (Fig. 10D). Pedipalp slightly less slender and elongated than in males. Femur: externoventral carina developed as a ridge with spiniform granules, these weaker, more scattered and less numerous than in male. Pedipalp patella (Fig. 10D). Less elongated than in males. Externodorsal carina developed as a ridge of weak granules, almost smooth. Internal and external surface shagreened, not granular. Pedipalp chela manus (Fig. 10D). Chela more bulky than in males. Pectines and genital operculum (Fig. 11B). Genital operculum composed of a hexagonal ovoid plate divided by a moderately deep longitudinal furrow; posterior notch weakly pronounced; pectines with 8-10 teeth.

*Intraspecific variation.* The specimens examined possess 10 to 12 trichobothria on the ventral side of the patella. Females have pectines with 8 to 10 teeth, usually 8-8, males have pectines with 14 to 17 teeth. The same remark about pedipalps and metasoma of males can be given as for *H. acanthocercus*.

***Hemiscorpius gaillardi*** (Vachon, 1974) comb. n.

Figs 13-15, 26C

*Habibiella gaillardi* Vachon, 1974: 952, fig. 105.

*Material examined.* Holotype: 1 ♀, IRAN, East, no locality specified, MNHN-RS 4328.

*Distribution.* Known from eastern Iran, no locality specified.

*Diagnosis.* (1) Carapace almost as wide as long, shagreened and sparsely granular, with few smooth patches and with coarse granules on anterior margin between lateral ocular tubercles; lateral margins with small spiniform granules below lateral ocular tubercles; superciliary carinae weak, finely granular; (2) pedipalps very elongated, chela fingers longer than chela manus; (3) internal protuberance of patella with internodorsal carina bearing 6 strong spiniform granules; (4) pedipalp patella neothobothriotaxic, external side with 15 trichobothria (2 *est* and 3 *esb*), ventral side with 10-12 trichobothria; (5) metasoma of females with dorsal carinae of segments I-IV and ventral and ventrolateral carinae of segments V bearing weak small spiniform granules.

The male of *H. gaillardi* remains unknown. For more details see also diagnosis of *H. enischnochela* sp. n., to which *H. gaillardi* is closely related.

*Description.* FEMALE. Measurements of holotype (MNHN-RS 4328). Carapace, length 6.6, posterior width 6.7; distance between anterior lateral eyes 3.6, between posterior lateral eyes 4.4, between median eyes 0.2; diameter of median eyes 0.3. Pedipalp, femur length 7.7, width 2.3; patella length 7.5, width 2.4, chela length 14.2; manus length 6.2, width 3.8, depth 2.7; movable finger length 7.7; fixed finger length 6.7. Metasoma, segment I length 4.5, width 2.2; segment V length 6.5, width 1.7, depth 1.9; vesicle length 4.2, width 2.3, depth 2.3, aculeus length 1.5. Total length 58.0.

Carapace (Fig. 26C). Colouration mostly uniformly pale yellow to orange; median and lateral ocular tubercle black. Carapace dorsoventrally flattened, almost as wide as long, with sides nearly parallel, slightly convergent; median ocular tubercle weakly developed, low, distinctly situated anteriorly, with superciliary carinae weak but finely granular. Frontal concavity or notch well-developed; anterior lobes truncate;



FIG. 13  
*Hemiscorpius gaillardi*, female holotype: A, dorsal aspect; B, ventral aspect. Scale line, 5 mm.

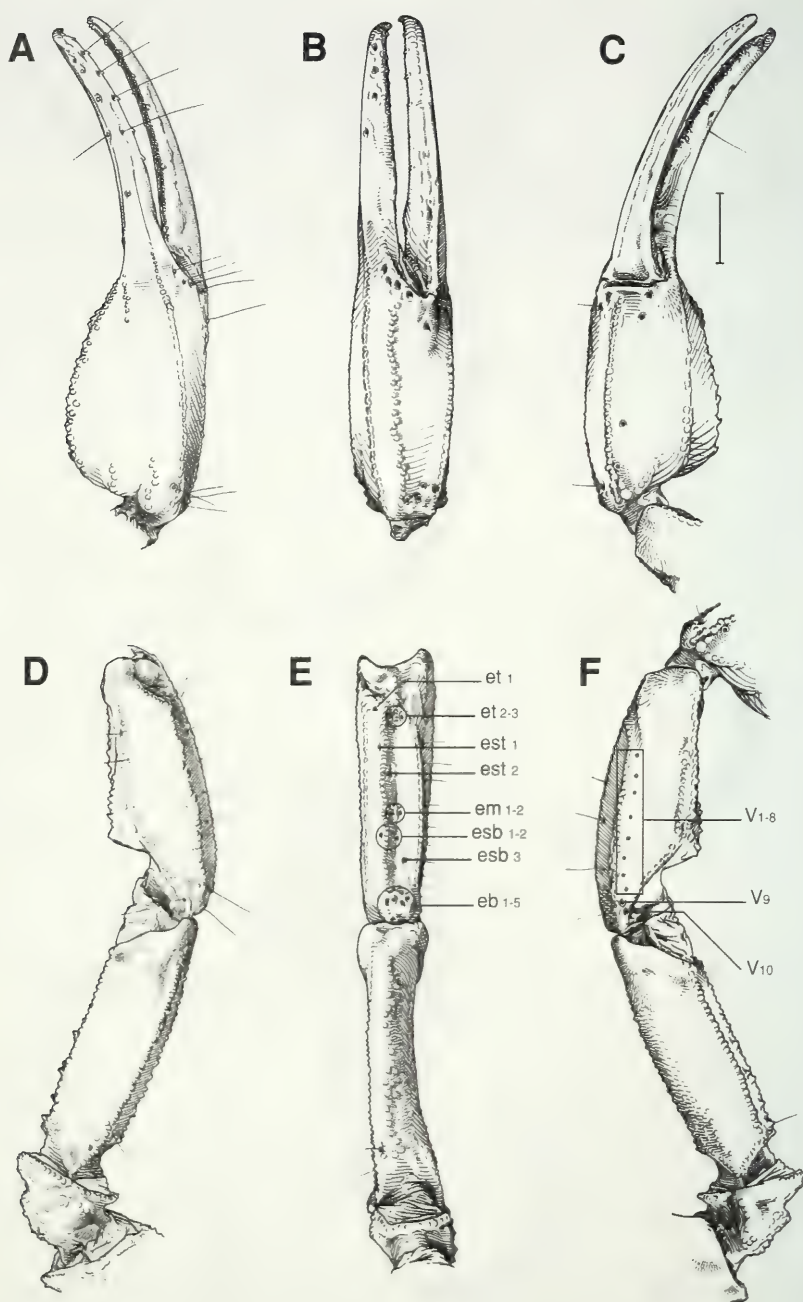


FIG. 14

*Hemiscorpius gaillardii*, female holotype, pedipalp with trichobothrial pattern: A, chela, dorsal aspect; B, idem, external aspect; C, idem, ventral aspect; D, femur and patella, dorsal aspect; E, idem, external aspect; F, idem, ventral aspect. Scale line, 2 mm.



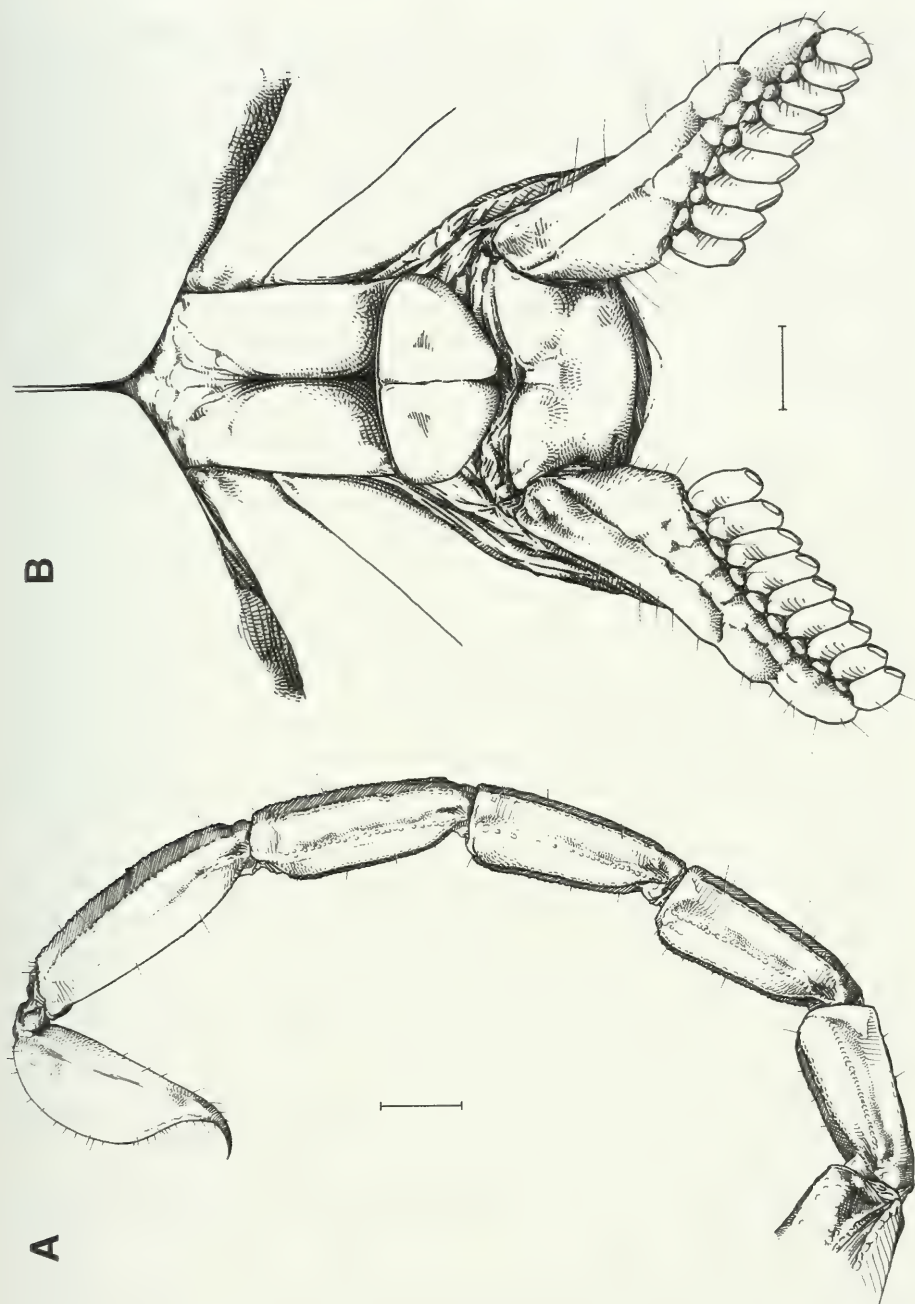


FIG. 15

*Hemiscorpius gaillardii*, female holotype: A, metasoma, lateral aspect (scale line, 2 mm); B, pectines and genital opercula, ventral aspect (scale line, 1 mm).

lateral ocular tubercles with 3 ocelli, the posterior one smaller than the 2 anteriors. Carapace shagreened and sparsely granular, with few smooth patches and with coarse granules on anterior margin between lateral ocular tubercles, each lobe with a smooth central area between median and lateral ocular tubercles; edges granular below lateral ocular tubercles; anteromedian furrow indistinct, very shallow, suturiform, anteriorly bifurcated; median longitudinal furrow indistinct, almost absent, very shallow, continuous from the anterior suture furcation, running through ocular tubercle posteriorly into a deep triangular depression; posterolateral furrow shallow; mesolateral furrow weakly developed, almost indiscernible.

Mesosoma. Tergite colouration dark yellow, with lighter (pale yellow) posterior margins. Tergites I-III with a shallow median depression divided anteriorly by a weak ridge, tergites IV-VII with median carina reduced to a weak, non-granular ridge surrounded by a pair of shallow, submedian depressions. Lateral and sublateral carinae absent on tergites I-VI, but present in posterior 2/3 of tergite VII, developed as weak ridges with weak, spiniform granules. Surface of tergites shagreened, with smooth patches; pre-tergites smooth, shiny and minutely pitted. Sternite colouration pale yellow. Sternites III-VI smooth, shiny and minutely pitted, without granulation or carinae; sternite III with a pair of large, very finely and densely granular depressions, situated under the pectines; sternites IV-VI with a pair of shallow median furrows. Sternite VII shagreened, very finely granular and with very few smooth patches; pair of lateral carinae, weak, smooth; median carinae absent. Spiracles of book lungs crescent-shaped. Tergites and sternites VII almost as long as wide.

Metasoma (Fig. 15A). Slender, predominantly shagreened. Colour dark yellow. Segments I-IV with longitudinal dorsomedian furrow, their dorsal carinae with spiniform granules. Segments I-III with lateral carinae developed as ridges with weak spiniform granules, almost smooth; segments IV with lateral carinae as almost smooth ridges. Ventrolateral carinae developed as almost smooth ridges on segments I-II; as smooth ridge with weak spiniform granules in posterior half of segment III; as ridge with weak spiniform granules on segment IV. Segment I: ventral carina almost indiscernible, reduced to a very weak ridge; segments II-IV with ventral carina a smooth ridge with weak spiniform granules on segment IV. Segment V: longitudinal dorsal furrow present in anterior half, dorsal carinae weakly marked, with small, very weak granules; lateral carina absent; ventrolateral carinae with weak spiniform granules; ventromedian carina with small spiniform granules.

Telson (Fig. 15A). Vesicle yellow to orange; aculeus darker, tan, due to stronger sclerotisation; vesicle elliptical or ovate, very bulky; ventrolateral furrows absent; ventromedian ridge absent; lateral surfaces smooth; dorsal surface smooth, with a median shallow depression anteriorly. Macrosetae very sparse basally, becoming more numerous near base of aculeus. Aculeus short, strongly curved, becoming markedly narrower approximately halfway.

Chelicerae. Colour pale yellow; teeth of fingers darker, orange. Teeth arrangement as in Scorpionidae (see Vachon, 1963); fixed finger with median and basal teeth bifid; movable finger with one subdistal tooth and one basal tooth in external series; distal external tooth smaller than distal internal tooth; cheliceral teeth without secondary serrations.

Pedipalp slender and elongated. Pedipalp coxa and femur (Fig. 14D-F). Inter-  
noventral margin of coxa with few strong spiniform granules. Dorsal surface of femur  
predominantly yellow, internodorsal, internoventral and externoventral carinae darker,  
orange. Femur slender, elongate (longer than 3 times its width), pentacarinata, with 4  
distinct carinae; internodorsal carina developed as a strongly and densely granular  
ridge, granules spiniform; externodorsal carina as a granular ridge; internoventral  
carina as a ridge with spiniform granules; externoventral carina as a ridge with strong  
spiniform granules; ventromedian carina reduced to few scattered granules and con-  
fined to base of femur. Dorsal surface shagreened, finely and densely granular, distal  
end smooth, without granules; internal surface shagreened, with few strong scattered  
spiniform granules; external surface shagreened; ventral surface shagreened and  
sparsely granular, distal end without granules. A total of 3 trichobothria present on  
femur; *d* located externobasally on dorsal surface; *i* located dorsobasally on internal  
surface; *e* located dorsobasally on external surface. Pedipalp patella (Fig. 14D-F)  
slender (length more than 2.5 times its width). Colour predominantly yellow; carinae  
slightly darker. 7 carinae present, 6 of them distinct; internodorsal carina developed as  
a ridge of coarse granules; externodorsal carina as a ridge of indistinct coarse granules  
(almost smooth); internoventral carina as a strongly granular ridge (spiniform  
granules); externoventral carina as a ridge of weak granules; externomedian carina as  
a granular ridge. Dorsal surface shagreened, sparsely and weakly granular; internal,  
external and ventral surfaces shagreened, without granules. Internal protuberance pro-  
nounced, bifid (internodorsal and internoventral tubercles separated), internodorsal  
carina with 6 strong spiniform granules. A total of 29-31 trichobothria present on  
patella, neobothriotaxy major; *d*<sub>1</sub> located basally, external to internodorsal carina; *d*<sub>2</sub>  
located in distal third of patella; *d*<sub>3</sub> absent; *i* in distal third of patella, located dorsally  
on internal surface. External (*e*) trichobothrial groups discernible and neobothriotaxic:  
*eb* group composed of 5 trichobothria, *esb* group of 3 trichobothria, *em* group of 2 tri-  
chobothria, *est* group of 2 trichobothria, *et* group of 3 trichobothria. Ventral (*v*) group  
neobothriotaxic, composed of 10 to 12 trichobothria. Pedipalp chela manus (Fig. 14A-  
C). Colour predominantly yellow; carinae, darker orange. Chela slender (length more  
than 3 times its width), with 5 distinct carinae; internodorsal carina continuous, with  
spiniform granules; subdigital carina vestigial, visible basally as a smooth ridge; ex-  
ternodorsal carina distinct, visible as a ridge of indistinct fused granules, almost  
smooth; digital carina a smooth ridge with few weak granules basally; dorsal  
secondary carina (dorsomedian) a smooth ridge with few strong granules basally and  
few weak granules distally; internoventral carina continuous, a weak ridge with spini-  
form granules; externoventral carina continuous, a granular ridge, running parallel to  
longitudinal axis of chela, its distal edge disconnected from external movable finger  
condyle and directed between external and internal movable finger condyles; ventro-  
median carina vestigial, reduced to few coarse granules basally; internal (interno-  
median) carina visible as a weak ridge with few spiniform granules; external (externo-  
median) carina weakly pronounced, visible as raised rows of small weak granules.  
Dorsal surface of chela shagreened, sparsely and weakly granular; internal surface sha-  
greened, sparsely granular, with a denser patch of spiniform granules dorsodistally;  
external surface shagreened, sparsely and weakly granular; ventral surface shagreened,



sparsely and weakly granular, distal end without granules. A total of 15 trichobothria present on chelal manus; *Db* trichobothria located externo-basally on dorsal surface; *Eb* group (3 trichobothria) orthobothriotaxic, located basally on external surface; *Esb* very close to *Eb* group; *Em* absent; *Est* located distally, very close to *Et* group; *Et* group composed of 5 trichobothria, *Et<sub>1</sub>* located ventrally; *V* group comprising 4 trichobothria, *V3* and *V4* located in the basal half of manus, *V1* and *V2* situated very distally. Pedipalp chela fingers (Fig. 14A-C). Dark reddish tan, with tips yellow-orange. Dorsal and ventral surfaces predominantly smooth, slightly shagreened and minutely pitted basally. Fingers longer than chela manus. Fixed finger with a very weak basal concavity, movable finger with corresponding lobe very weakly developed. Tips of fingers with pronounced distal hook. Fingers with distal diastema; edges of fingers composed of 2 rows of denticles becoming fused basally, interrupted at regular intervals by stronger granules, each of them coupled with an accessory granule; rows fused into a single row above concavity on fixed finger and on notch of movable finger, single basal row running towards base of fingers. A total of 11 trichobothria present on fingers; *Dt* located basally on dorsal surface of fixed finger; *db* located dorsally on internal surface, approximately midway on the fixed finger; *dsb*, *dst* and *dt* on dorsal surface, in distal third of finger; *eb* located dorsally on external surface, midway on fixed finger, opposite *db*; *esb*, *est* and *et* in distal third of fixed finger; *esb*, *est* and *et*, opposite *dsb*, *dst* and *dt*, respectively; *it* and *ib* located in distal half of fixed finger.

Coxosternal sclerites. Dark yellow to orange; smooth. Anterior margin of coxapophysis I smooth, with few weak granules, expanded but not sub-triangular in shape. Sternum of type 2 (Soleglad & Fet, 2003), longer than wide, pentagonal, shagreened; median furrow deep, more pronounced in posterior half; posterior pit absent.

Legs. Pale yellow. Predominantly smooth, dorsal surfaces of trochanter and femur finely and weakly granular. Tarsus with a ventromedian row of microspinules and with 2 rows of rigid "spinoid" ventral macrosetae; tarsi I-II: prolateral row with 5-6 macrosetae, retrolateral row with 7 macrosetae; tarsi III-IV: prolateral row with 6 macrosetae, retrolateral row with 7 macrosetae; setae acuminate; tarsal claws of equal length.

Pectines and genital operculum (Fig. 15B). Colour pale yellow; genital operculum composed of a single subtriangular plate, posterior extremity truncate, longitudinal median furrow relatively deep, posterior notch pronounced; pectines with 9/9 teeth.

### *Hemiscorpius lepturus* Peters, 1861

Figs 1A-B, 16-21, 27E-F, 36

*Hemiscorpius lepturus* Peters, 1861a: 426-427, 8 figs.

*Syntypes* (not examined). 1 ♂ (*ZMB 43a*), 1 ♀ (*ZMB 43b*), IRAQ, Baghdad; 2 specimens (*ZMB 43*), IRAQ, Mendeli; YEMEN, Aden.

*Material examined*. 1 ♀ (7408), IRAN (Kohkiluyeh), Charam road, 22.V.1974, A. Senglet, *MHNG*. 1 ♀ juv. (7412b), IRAN (Kohkiluyeh), Yasudj road, 25.V.1974, A. Senglet, *MHNG*. 1 ♂ (2002/27), IRAN (Ghilan), 2 km W Cham-Khaled (Sea Star, Hotel Resort), nsl, 37°14.922'N, 50°15.037'E, 10.V.2002, B. Schätti, *MHNG*. 2 ♂, 2 ♀, IRAN (Khuzestan), Ahwaz region, 21.XI.1995, B. Masihpour, *MHNG*. 1 ♂, IRAN, ? Lali, VI.1961, M. Vasserot, *MNHN-RS 4332*. 1 ♀ juv., IRAN, 28.III.1961, M. Vasserot, *MNHN-RS 4333*. 1 ♂, 1 ♀, without locality, *MNHN-RS 5232 (122-123)*. 2 ♂, 2 ♀, 4 ♂ subadult, IRAN (Khuzestan), Masched-Soleyman, R. Farzanpay ?, *MHNG (SF 0006/13-20)*. 1 ♂ juv., 1 ♀, 2 ♀ juv., IRAN (Fars), ca. 90 km W Shiraz,



FIG. 16

*Hemiscorpius lepturus*. Male (MNHN-RS 5232): A, dorsal aspect; B, ventral aspect. Female paratype (MNHN, SF0006/17): C, dorsal aspect; D, ventral aspect. Scale line, 5 mm.

14.IV.1970, G. Pretzman, K. Bilek and F. Ressler, *NHMW 3390*. 1 ♂ subadult, 3 ♀, IRAN (Fars), ca. 5 km NE Persepolis, 20.IV.1970, G. Pretzmann, K. Bilek and F. Ressler, *NHMW 3391*. 1 ♂ juv., 1 ♀, 1 ♀ juv., IRAN (Fârs), ca. 18 km SE Abadeh, 20.IV.1970, G. Pretzman, K. Bilek and F. Ressler, *NHMW 3392*.

*Distribution* (completed with data from the literature). Esfahan, Fars, Hamadan, Kohkiluyeh, Khuzestan and Lorestan Provinces, south western Iran, eastern Iraq (Fig. 36). The distribution area of *Hemiscorpius lepturus* mentioned by Fet (2000) also includes the west of Pakistan. However, this is not confirmed by the present study. The species seems to be restricted to Iraq and the western and south western regions of Iran.

*Diagnosis*. (1) Carapace longer than wide, very finely granular with anterior area smooth and minutely pitted, and area around median ocular tubercle very finely granular; lateral margins smooth, without granules; superciliary carinae weak, smooth; (2) pedipalps stout and bulky, with weaker and less distinct granular carinae than in any other Iranian Hemiscorpiidae, chela fingers slightly shorter than chela manus; (3) internodorsal carina of patellar protuberance smooth, with 1-2 weak granules; (4) pedipalp patella orthobothriotaxic, external side with 13 trichobotria (1 *est* and 2 *esb*), ventral side with 3 trichobotria; (5) metasoma of males elongated and slender, with dorsal carinae bearing sparse spiniform granules (weaker granules on anterior segments), and ventral and ventrolateral carinae of segments IV-V developed as ridges with weak spiniform granules (carinae of segment V with more distinct spiniform granules in posterior half); (6) telson of males strongly elongated, bearing a pair of blunt tuberculiform processes at base of aculeus, lateral surfaces rugose, without distinct granules; (7) metasoma of females with dorsal carinae of segments I-IV and ventral and ventrolateral carinae of segment V bearing strong spiniform granules; (8) hemispermatophore with double lamellar hook located above distal transverse ridge and pointing distally.

See also diagnosis of *H. acanthocercus* sp. n., to which *H. lepturus* is closely related.

*Description*. MALE (Figs 1A-B, 16A-B, 17A, 18A-C, E-F, 19A, 20, 21, 27F). Measurements of specimen MNHN-RS 5232. Carapace, length 6.4, posterior width 5.8; distance between anterior lateral eyes 3.6, between posterior lateral eyes 4.0, between median eyes 0.2; diameter of median eyes 0.2. Pedipalp, femur length 6.0, width 2.2; patella length 5.8, width 2.2, chela length 10.8; manus length 6.0, width 4.4, depth 2.7; movable finger length 5.1; fixed finger length 3.8. Metasoma, segment I length 8.0, width 2.2; segment V length 10.4, width 1.6, depth 1.9; vesicle length 7.2, width 1.7, depth 2.0, aculeus length 0.8. Total length 85.0.

Carapace (Fig. 17A). Colouration yellow to light orange; median and lateral ocular tubercle black. Carapace dorsodistally flattened, longer than wide, almost rectangular in shape, with sides nearly parallel; median ocular tubercle weakly developed, very low, distinctly situated anteriorly, with superciliary carinae weak and smooth; frontal concavity or notch well-developed; anterior lobes truncate; lateral ocular tubercles with 3 ocelli, the posterior one smaller than the 2 anteriors. Carapace very finely granular, with few smooth patches; anterior area between median ocular tubercle and anterior margin smooth and minutely pitted, area around median ocular tubercle very finely granular; edges usually smooth, sometimes with very few weak granules below lateral ocular tubercles; anteromedian furrow narrow, suturiform, anteriorly bifurcated; median longitudinal furrow shallow, continuous from anterior suture



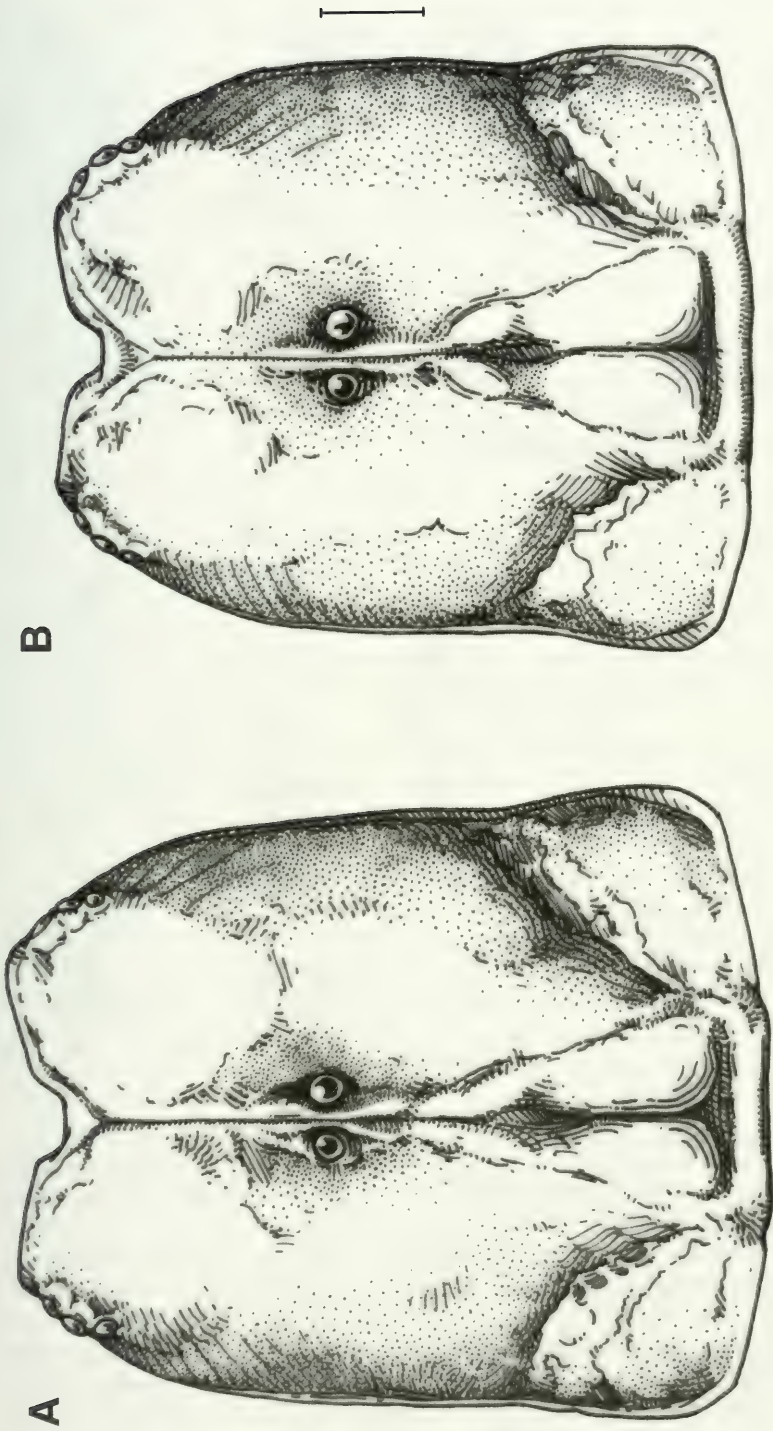


FIG. 17  
*Hemiscorpius lepturus*, carapace, dorsal aspect (MNHN-RS 5232): A, male; B, female. Scale line, 1 mm.

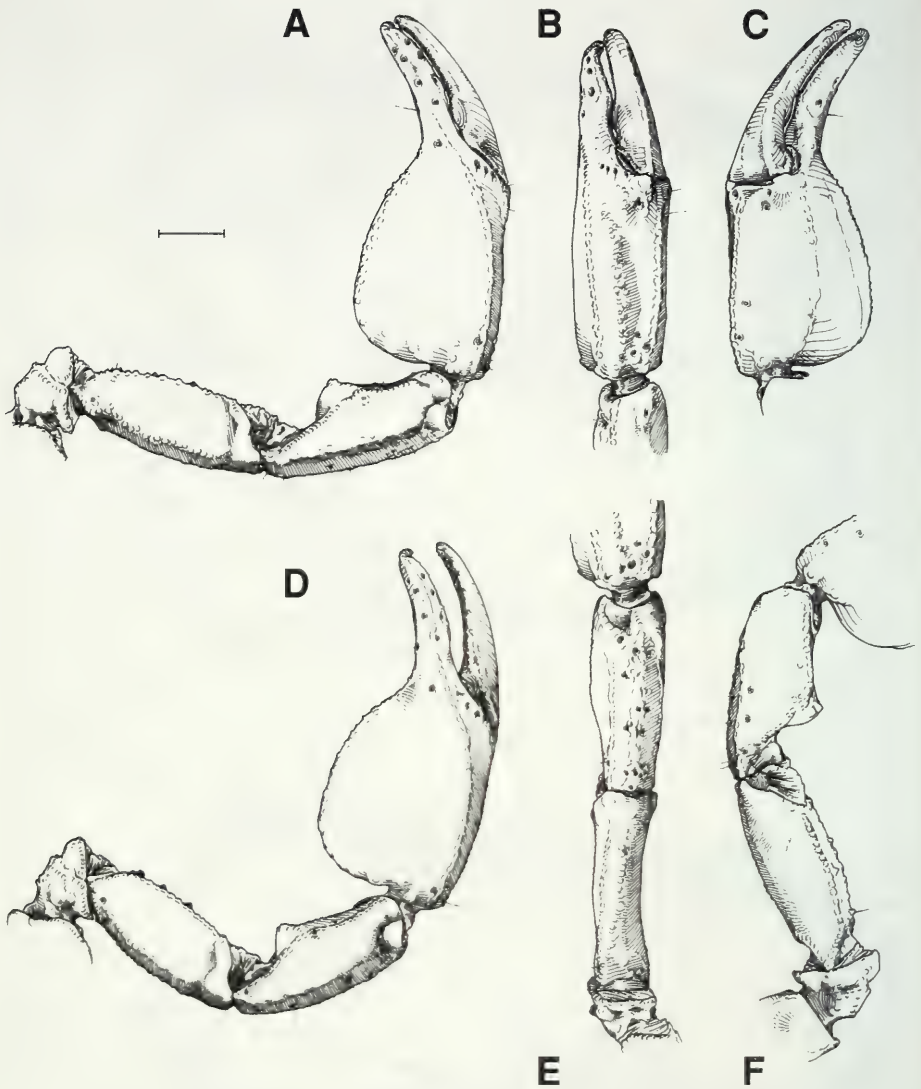


FIG. 18

*Hemiscorpius lepturus*, male (MNHN-RS 5232): A, pedipalp with trichobothrial pattern, dorsal aspect; B, chela, external aspect; C, idem, ventral aspect; E, femur and patella, external aspect; F, idem, ventral aspect. Female (MNHN-RS 5232): D, pedipalp, dorsal aspect. Scale line, 2 mm.

furcation, running through ocular tubercle posteriorly into a deep triangular depression; postero-lateral furrow shallow; mesolateral furrow weakly developed, almost indiscernible.

Mesosoma. Tergite colouration pale yellow. Tergite VII longer than wide. Tergite I without any depressions or carinae, tergites II-III with a shallow median depression divided anteriorly by a weak ridge, tergites IV-VII with median carina

reduced to a weak, non-granular ridge surrounded by a pair of shallow, submedian depressions. Lateral and sublateral carinae absent on tergites I-VI, but present in posterior 2/3 of tergite VII, developed as ridges with indistinct granules, almost smooth. Surface of tergites finely granular; pre-tergites smooth, shiny and minutely pitted. Sternite colouration pale yellow. Sternite III smooth, shiny and minutely pitted, with a large, rough, very finely granular depression under each pectine; sternite IV-VI smooth, shiny and minutely pitted, without granulation or carinae, with a pair of shallow median furrows. Sternite VII smooth, shiny, minutely pitted medially and finely granular laterally and posteriorly; a pair of weakly developed, smooth lateral carinae in posterior half; median carinae absent. Spiracles of book lungs crescent-shaped. Tergites and sternites VII longer than wide.

Metasoma (Fig. 27F). Very elongated and slender, slightly shagreened, with fine scattered granules. Colour yellow to light orange. Segments I-IV with longitudinal dorsomedian furrow, dorsal carinae developed as ridges with scattered spiniform granules becoming more numerous on posterior segments, lateral carinae as smooth ridges without granules. Segments I-II with ventrolateral carinae developed as smooth ridges; segments III-IV with ventrolateral carinae as ridges of indistinct granules, almost smooth. Segment I with ventral carina almost absent, reduced to a weak ridge; segments II-III with ventral carina a smooth ridge; segment IV with ventral carina a ridge of fused granules, almost smooth. Segment V: longitudinal dorsal furrow present in anterior half; dorsal carinae with small spiniform granules posteriorly; lateral carina developed as a weak ridge; ventrolateral and ventromedian carinae as ridges of indistinct granules, almost smooth anteriorly and with reduced spiniform granules in posterior half.

Telson (Figs 1A-B, 27F). Vesicle yellow; aculeus darker, tan, due to stronger sclerotisation; vesicle elliptical or ovate, strongly elongated, with a blunt tuberculiform projection on each side at base of aculeus; ventrolateral furrows and ventromedian ridge absent; lateral surfaces irregular, with numerous weak granules; dorsal surface with numerous small spiniform granules and a median shallow depression. Macrosetae very sparse basally, becoming more numerous near base of aculeus. Aculeus short and stout, strongly curved, becoming markedly narrower approximately midway.

Chelicerae. Colour pale yellow; teeth of fingers darker, orange. Teeth arrangement as in Scorpionidae (see Vachon, 1963); fixed finger with median and basal teeth bifid; movable finger with one subdistal tooth and one basal tooth in external series; distal external tooth smaller than distal internal tooth; cheliceral teeth without secondary serrations.

Pedipalp short and stout. Pedipalp coxa and femur (Fig. 18A, E-F). Coxa with internoventral margin mostly smooth, with only few strong spiniform granules. Dorsal surface of femur yellow, internodorsal, internoventral and externoventral carinae darker, orange. Femur short, stout (length less than 2.5 times its width), pentacarinata, with 4 distinct carinae; internodorsal carina developed as a strongly granular ridge; externodorsal carina reduced to a slightly raised row of granules; internoventral carina developed as a strongly granular ridge; externoventral carina as a weak granular ridge; ventromedian carina reduced to few granules and confined to base of femur. Dorsal surface shagreened, finely and densely granular, distal end smooth, without granules;



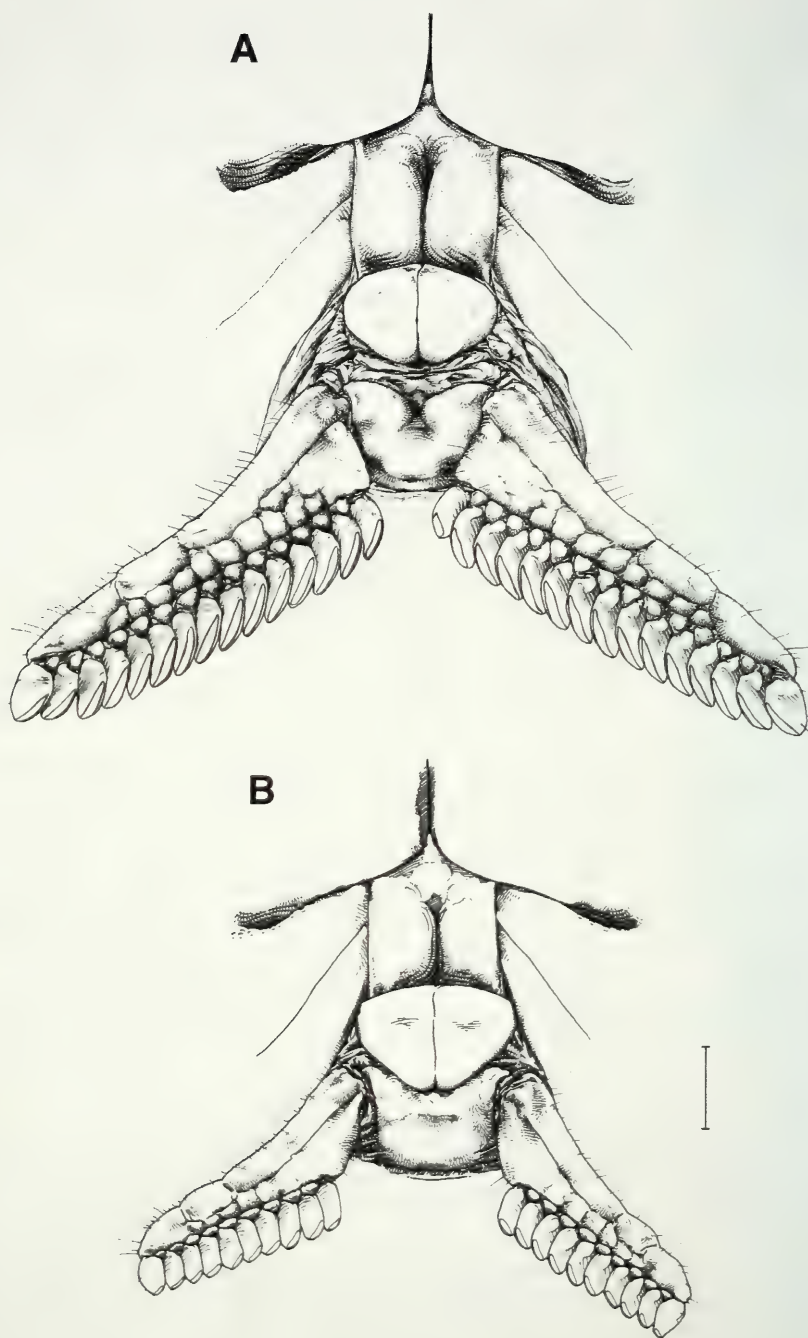


FIG. 19

*Hemiscorpius lepturus*, pectines and genital opercula, ventral aspect: A, male (MNHN-RS5232); B, female (MHNG, SF 0006). Scale line, 1 mm.

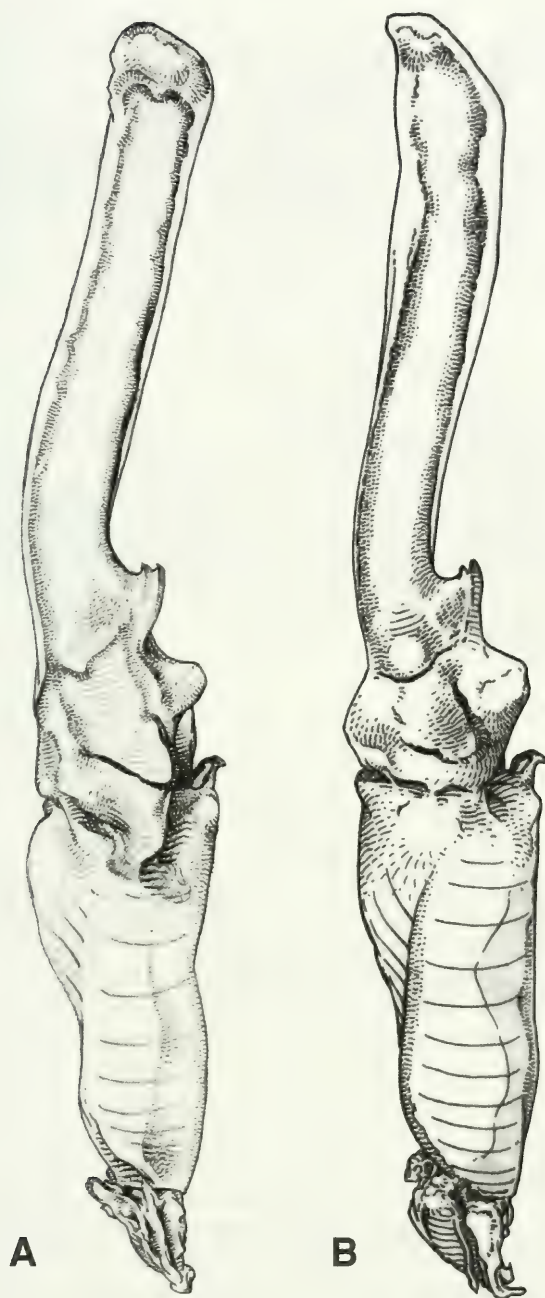


FIG. 20

*Hemiscorpius lepturus*, hemispermatophores of two males, external aspect: A, male from Masched-Soleyman (MHNG, SF 0006); B, male from Iran, without precise locality (MNHN-RS 4332). Scale line, 0.5 mm.

internal surface shagreened, with few strong scattered spiniform granules; external surface slightly shagreened; ventral surface finely and densely granular, with shagreened patches, distal end without granules. A total of 3 trichobothria present on femur; *d* located externobasally on dorsal surface; *i* located dorsobasally on internal surface; *e* located dorsobasally on external surface. Pedipalp patella (Figs 18A, E-F) short and stout (length less than 2.5 times its width). Colour predominantly yellow; carinae slightly darker, orange. 7 carinae present, 6 of them distinct; internodorsal carina developed as a ridge of indistinct coarse granules; externodorsal carina as a weak ridge of indistinct granules, almost smooth; internoventral carina as a ridge of indistinct granules, almost smooth; externoventral carina as a smooth weak ridge, almost indiscernible; externomedian carina as a ridge of weak coarse granulae, almost smooth. Dorsal surface finely and weakly granular, with small shagreened patches; internal surface shagreened, with few small scattered granules; external surface minutely pitted, with shagreened patches; ventral surface weakly and finely granular, with shagreened patches, distal end smooth and minutely pitted. Internal protuberance weak, bifid (internodorsal and internoventral tubercles separated), dorsal carina smooth, with 1-3 weak granules. A total of 19 trichobothria present on patella, orthobothriotaxy; *d*<sub>1</sub> located basally, external to internodorsal carina; *d*<sub>2</sub> located submedially on patella; *d*<sub>3</sub> absent; *i* in distal half of patella, located dorsally on internal surface. External (*e*) trichobothrial groups discernible and orthobothriotaxic: *eb* group composed of 5 trichobothria, *esb* group of 2 trichobothria, *em* group of 2 trichobothria, *et* group of 3 trichobothria; *est* very close to *et* group. Ventral (*v*) group orthobothriotaxic, 3 trichobothria. Pedipalp chela manus (Figs 18A-C). Colour predominantly yellow; carinae and fingers darker, orange. Chela short and stout (length less than 2.5 times its width), with 5 distinct carinae; internodorsal carina weakly developed, visible as a row of few granules, highlighted by a slightly darker line; subdigital carina vestigial, a smooth, weak ridge, more distinct basally; externodorsal carina vestigial, visible as a ridge of indistinct granules, almost smooth; digital carina vestigial, visible as a smooth, weak ridge more distinct basally; dorsal secondary carina (dorsomedian) vestigial, visible as a very weak, smooth ridge with a few weak granules basally; internoventral carina not continuous, developed as a weak, smooth ridge, with a few weak granules distally, less distinct basally; externoventral carina continuous, developed as a ridge of weak fused granules, smooth distally, running parallel to longitudinal axis of chela, its distal edge disconnected from external movable finger condyle and directed between external and internal movable finger condyles; ventromedian carina reduced to 1-2 coarse granules basally; internal (internomedian) carina vestigial, visible as a row of very few sparse granules; external (externomedian) carina weakly developed, visible as ridge of small indistinct granules. Dorsal surface smooth and minutely pitted, with patches of a subreticulate network of weak granular ridges and shallow shagreened dimples; internal surface sparsely and finely granular, with small shagreened patches, with a patch of stronger spiniform granules dorsodistally; external surface minutely pitted, forming an irregular and subreticulate network of weakly and finely granular ridges and shallow shagreened dimples; ventral surface smooth and minutely pitted, with few small shagreened patches. A total of 15 trichobothria present on chela manus; *Db* trichobothria located externobasally on dorsal surface; *Eb* group



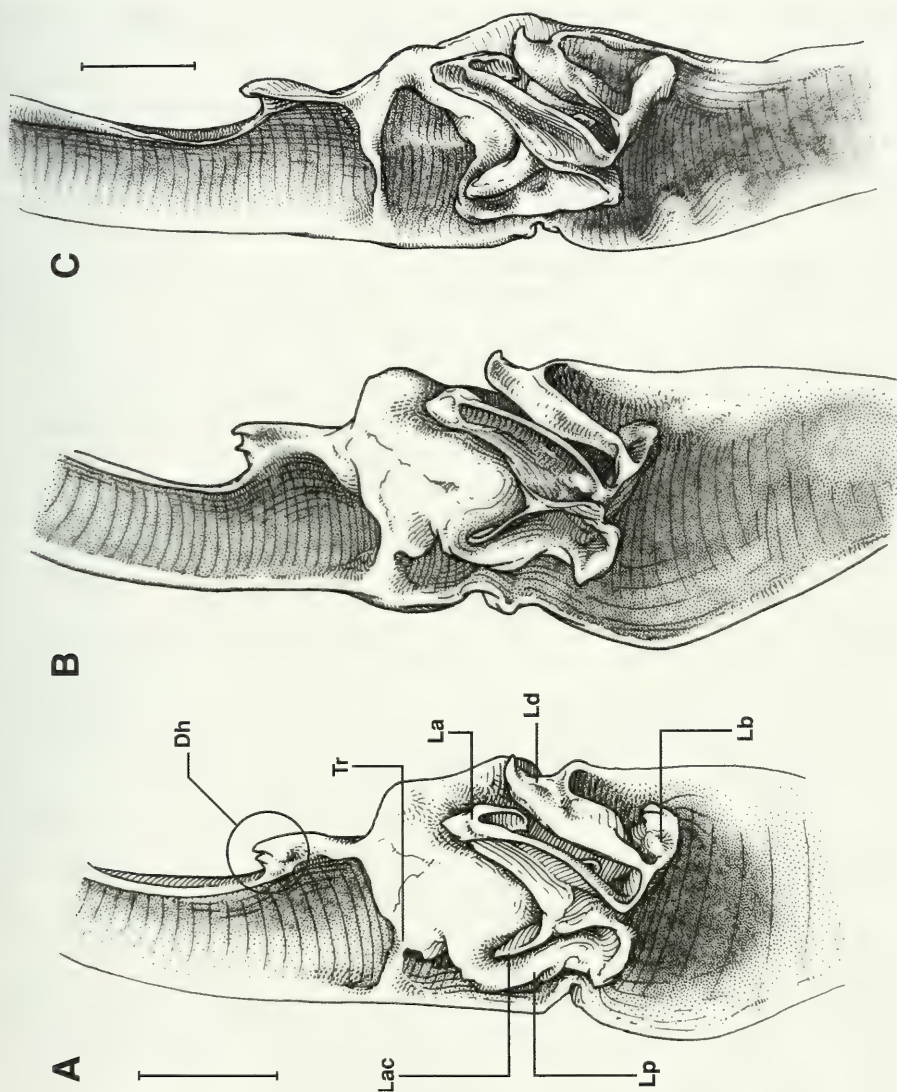


FIG. 21

*Hemiscorpius lepturus*, hemispermaphores of two males, detail of capsular region, internal aspect: A-B, male from Iran, without precise locality (MNHN-RS 4332), Dh (double hook), La (lamella), Lac (accessory lobe), Lb (basal lobe), Ld (distal lobe), Lp (posterior lobe), Tr (transverse ridge); C, male from Masched-Soleyman (MHNG, SF 0006). Scale lines, 0.5 mm.

(3 trichobothria) orthobothriotaxic, located basally on external surface; *Esb* very close to *Eb* group; *Em* absent; *Est* located distally, very close to *Et* group; *Et* group composed of 5 trichobothria, *Et<sub>1</sub>* located ventrally; *V* group comprising 4 trichobothria, *V3* and *V4* located in the basal half of manus, *V1* and *V2* located very distally. Pedipalp chela fingers (Figs 18A-C). Dark orange to reddish tan, smooth, minutely pitted basally.

Fingers slightly shorter than chela manus. Fixed finger with a weak basal concavity, movable finger with corresponding lobe weakly developed. Tips of fingers with distal hook. Fingers with distal diastema; edges of fingers composed of 2 rows of denticles becoming fused basally, interrupted at regular intervals by stronger granules, each of these coupled with an accessory granule; rows fused into a single row above concavity on fixed finger and on notch of movable finger, single basal row running towards base of fingers. A total of 11 trichobothria present on chelal fingers; *Dt* located very basally on dorsal surface of fixed finger; *db* located dorsally on internal surface, in basal half of fixed finger; *dsb*, *dst* and *dt* on dorsal surface, in distal half of finger; *eb* located dorsally on external surface in basal half of fixed finger, opposite *db*; *esb*, *est* and *et* in distal half of fixed finger; *esb*, *est* and *et*, opposite *dsb*, *dst* and *dt*, respectively; *it* and *ib* located midway on fixed finger.

Coxosternal sclerites. Yellow; smooth and minutely pitted. Anterior margin of coxapophysis I smooth, with few weak granules, expanded but not sub-triangular in shape. Sternum of type 2 (Soleglad & Fet, 2003), longer than wide, pentagonal, smooth and minutely pitted; median furrow deep, more pronounced in posterior half; posterior pit absent.

Legs. Pale yellow. Predominantly shagreened; dorsal surfaces of trochanter and femur finely and densely granular; ventral surface smooth and minutely pitted. Tarsus with a ventromedian row of microspinules and with 2 rows of rigid "spinoid" ventral macrosetae; tarsi I-II: prolateral row with 5-6, retrolateral row with 7 macrosetae; tarsi III-IV: prolateral and retrolateral rows with 7 macrosetae; tarsal claws of equal length.

Pectines and genital operculum (Fig. 19A). Pale yellow; genital operculum composed of 2 ovoid plates; genital papillae short, not protruding from beneath operculum; pectines with 14-16 teeth, usually 15/15.

Hemispermaphore (Figs 20-21). Lamelliform, with complex capsule; distal lamella slender, basally curved, with a double hook pointing distad and located basally, flagellum approximately 1.5 times longer than capsule region; distal crest absent. Double lamellar hook (Dh) located above transverse distal ridge (Tr), the latter costate, distally strongly curved towards anterior margin, continuous from posterior to anterior margins, not merging with lamellar hook, reaching anterior margin of distal lamella below its hook. Capsule lamella (La) broad, with a deep longitudinal furrow and forming an acute angle to longitudinal axis of capsule, bearing a strong hook on its external surface and an accessory lobe (Lac) on its posterior margin; ventral margin straight. Distal lobe (Ld) forming a strong hook pointing anteriad; basal margin straight. Basal lobe (Lb) absent. Posterior lamella (Lp) costate.

FEMALE (Figs 16C-D, 17B, 18D, 19B, 27E). Measurements of specimen MNHN-SF0006/18. Carapace, length 6.0, posterior width 5.6; distance between anterior lateral eyes 3.4, between posterior lateral eyes 3.8, between median eyes 0.2; diameter of median eyes 0.2. Pedipalp, femur length 5.7, width 2.1; patella length 5.6; width 2.1, chela length 10.7; manus length 6.0, width 4.5, depth 2.5; movable finger length 4.9; fixed finger length 3.6. Metasoma, segment I length 3.9, width 2.3; segment V length 5.7, width 1.6, depth 2.0; vesicle length 3.9, width 2.3, depth 2.3, aculeus length 1.1. Total length 56.0.

Same characters as in males, except as follows. Carapace (Fig. 17B) less elongated than in male, almost as wide as long. Carapace finely granular, with larger

longitudinal median area smooth and minutely pitted; area around median ocular tubercle finely and densely granular. Mesosoma. Tergite VII as wide as long. Surface of tergites smooth, shiny and minutely pitted, finely granular laterally; pre-tergites smooth, shiny and minutely pitted, tergites VI-VII more granular than others. Sternite VII as wide as long. Metasoma (Fig. 27E). Short and relatively stout, slightly shagreened, with fine scattered granules. Carinae generally more granular than in males, spiniform granules stronger. Segments I-IV, dorsal carinae developed as ridges with spiniform granules (denser than in males), lateral carinae as weakly granular ridges. Segments I-II with ventrolateral carinae developed as weakly granular ridges, segment III-IV with ventrolateral carinae bearing weak spiniform granules. Segments I-II with ventral carina reduced to a smooth ridge; segments III-IV with ventral carina a ridge of weak spiniform granules. Segment V: dorsal carinae with weak spiniform granules; lateral carina vestigial, reduced to a row of scattered granules, ventrolateral carinae with spiniform granules; ventromedian carina with spiniform granules. Telson (Fig. 27E). Vesicle ovoid, globular and bulky; lateral surfaces smooth, slightly irregular. Aculeus without tubercles at its base, narrowing slightly less marked than in male. Pedipalp (Figs 18D). Slightly shorter and stouter than in males. Pedipalp chela fingers (Figs 18D). Fixed and movable fingers with slightly weaker basal concavity and lobe, respectively. Pectines and genital operculum (Fig. 19B). Genital operculum composed of a single subtriangular plate, posterior extremity truncate, longitudinal median furrow relatively deep, posterior notch pronounced; pectines with 9-11 teeth, usually 10/10.

*Intraspecific variation.* The size of males can vary greatly from 52 mm up to 85 mm body length, females display less variation in size. Females have pectines with 8-11 teeth, usually 10-10, males have pectines with 14-16 teeth. The same remark about pedipalps and metasoma of males can be given as for *H. acanthocercus*.

### *Hemiscorpius persicus* Birula, 1903

Figs 22-25, 36

*Hemiscorpion persicum* Birula, 1903: 77-80.

*Material examined.* Syntypes: 1 ♂, IRAN (Sīstān va Balūchestan), "Province Ssarbas", village Riss, 24.II.1901, N. Zarudny, *ZISP 1120*; 1 ♂ subadult, IRAN (Sīstān va Balūchestan), "Province Ssarbas", on the road between village Riss and locality Kaptegin-Dukan, 24-26.II.1901, N. Zarudny, *ZISP 1120*.

*Distribution.* Known only from Sīstān va Balūchestan Province, Eastern Iran (Fig. 36).

*Diagnosis.* (1) Carapace longer than wide, shagreened and finely granular, with small smooth patches; lateral margins with small spiniform granules below lateral ocular tubercles; superciliary carinae finely granular; (2) pedipalps relatively stout and bulky, chela fingers slightly shorter or equal in size to chela manus; (3) internal protuberance of pedipalpal patella with internodorsal carina bearing 1-2 strong spiniform granules, usually 2; (4) pedipalp patella orthobothriotaxic, external side with 13 trichobotria (1 *est* and 2 *esb*), ventral side with 3 trichobothria; (5) metasoma of males relatively elongated and slender, with dorsal carinae of segments I-V and ventral and ventrolateral carinae of segments IV-V bearing spiniform granules; (7) telson of males not strongly elongated, without blunt tuberculiform processes at base of aculeus.





FIG. 22

*Hemiscorpius persicus*, male syntype (ZISP 1120): A, dorsal aspect; B, ventral aspect. Scale line, 2.5 mm.

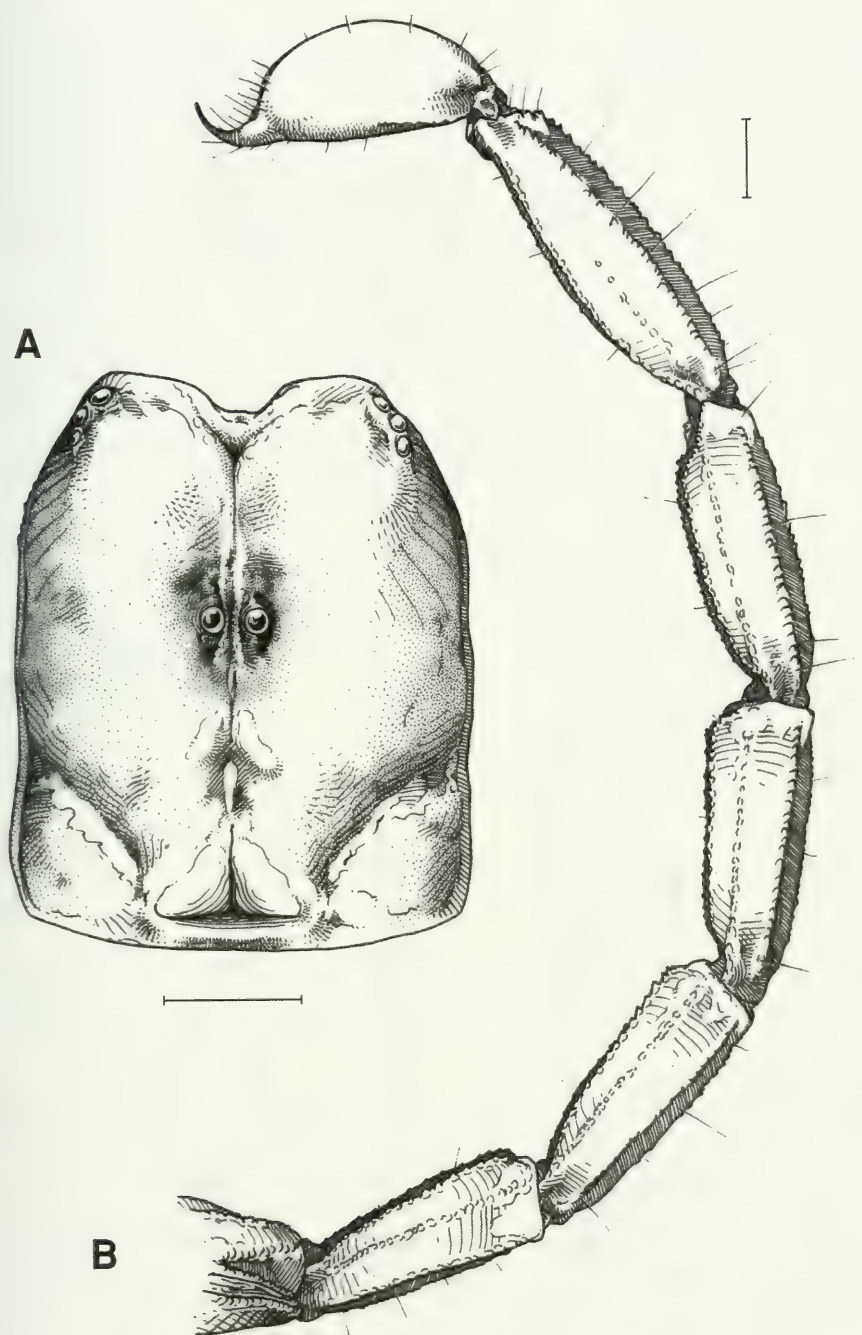


FIG. 23

*Hemiscorpius persicus*, male syntype (ZISP 1120): A, carapace, dorsal aspect; B, metasoma, lateral aspect. Scale lines, 1 mm.

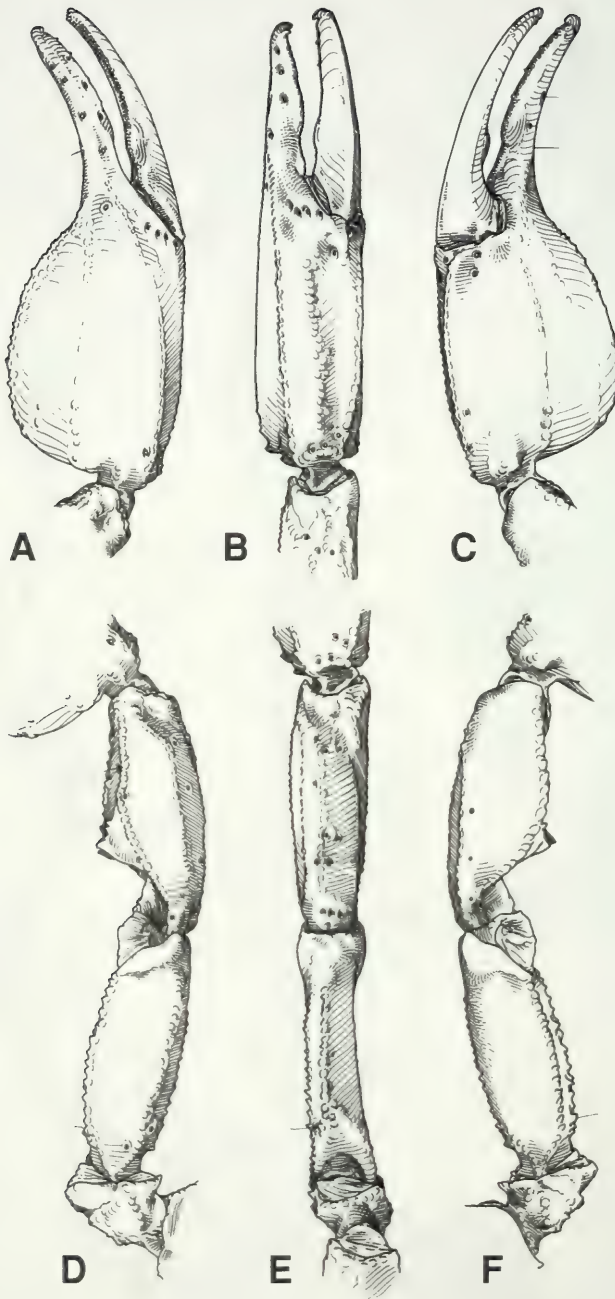


FIG. 24

*Hemiscorpius persicus*, male syntype (ZISP 1120), pedipalp with trichobothrial pattern: A, chela, dorsal aspect; B, idem, external aspect; C, idem, ventral aspect; D, femur and patella, dorsal aspect; E, idem, external aspect; F, idem, ventral aspect. Scale line, 1 mm.



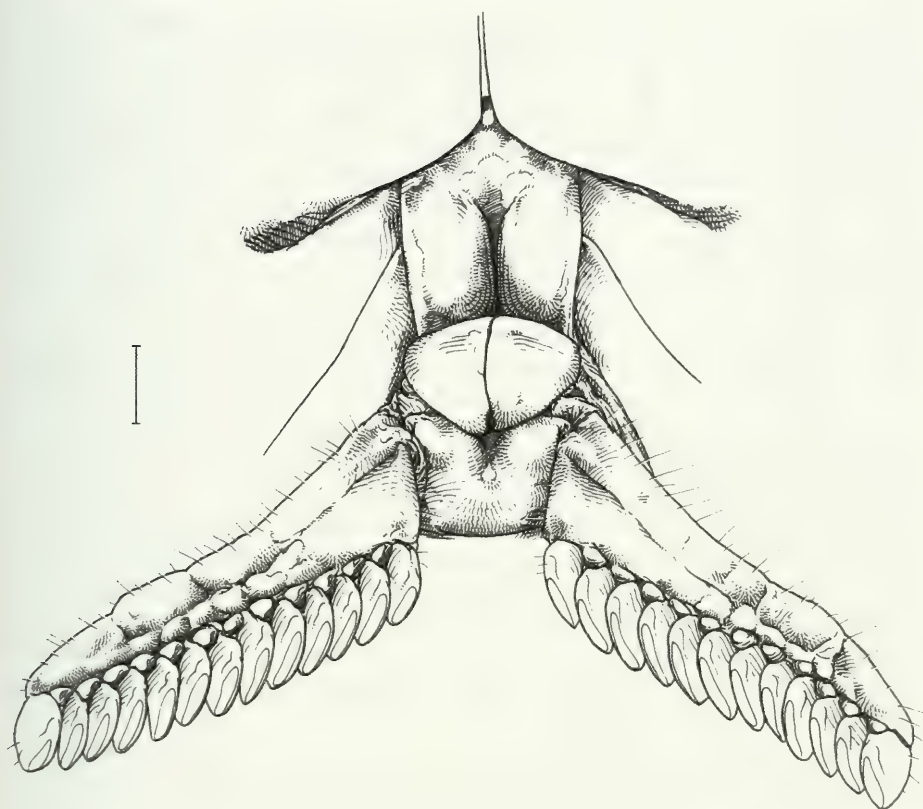


FIG. 25

*Hemiscorpius persicus*, male syntype (ZISP 1120): pectines and genital opercula, ventral aspect. Scale line, 0.5 mm.

*H. persicus* is very different from all the others Iranian *Hemiscorpius*. Despite possessing a relatively slender metasoma, the male does not show the extreme sexual dimorphism of metasoma and telson observed in the other Iranian species and can therefore be easily distinguish from them.

**Description.** MALE (description based on the syntype, ZISP 1120). Measurements of syntype (ZISP 1120). Carapace, length 4.0; posterior width 3.4; distance between anterior lateral eyes 2.0, between posterior lateral eyes 2.4, between median eyes 0.1; diameter of median eyes 0.1. Pedipalp, femur length 4.2, width 1.5; patella length 4.2, width 1.4, chela length 8.0; manus length 4.2, width 2.8, depth 1.7; movable finger length 4.1; fixed finger length 3.2. Metasoma, segment I length 3.2, width 1.4; segment V length 4.6, width 1.1, depth 1.3; vesicle length 2.8, width 1.1, depth 1.4, aculeus length 0.9. Total length 39.0.

Carapace (Fig. 23A). Colouration mostly uniformly dark yellow to orange; median and lateral ocular tubercles black. Carapace dorsodistally flattened, longer than wide, almost rectangular in shape, with sides nearly parallel; median ocular tubercle weakly developed, low, distinctly situated anteriorly, with weak, finely granular super-

ciliary carinae; frontal concavity or notch well-developed; anterior lobes truncate; lateral ocular tubercles with 3 ocelli, the posterior one smaller than the 2 anteriors. Carapace shagreened, finely and densely granular, with a few smooth patches; larger smooth patches in median area of anterior lobes between median and lateral ocular tubercles; lateral margins with small spiniform granules below lateral ocular tubercles; anteromedian furrow narrow, suturiform, anteriorly bifurcated; median longitudinal furrow shallow, continuous from anterior suture furcation, running through ocular tubercle, becoming wider posteriorly before merging with a deep triangular depression; posterolateral furrow shallow; mesolateral furrow weakly developed, almost indiscernible.

Mesosoma. Tergite colouration dark yellow to orange anteriorly, becoming lighter (yellow) posteriorly. Tergites I-III with a very shallow median depression divided anteriorly by a very weak ridge, tergites IV-VII with median carina reduced to a very weak ridge surrounded by a pair of shallow, submedian depressions. Lateral and sublateral carinae absent on tergites I-VI, but present in posterior 2/3 of tergite VII, developed as ridges bearing strong spiniform granules. Surface of tergites shagreened, finely and densely granular; pre-tergites smooth. Sternite colouration dark yellow. Sternites III-VI smooth, slightly granular laterally, without carinae; sternite III with a pair of large, very finely and densely granular depressions covered by the pectines; sternites IV-VI with a pair of shallow median furrows. Sternite VII shagreened, finely and densely granular; pair of lateral carinae developed as granular ridges; median carinae absent. Spiracles of book lungs crescent-shaped. Tergites and sternites VII longer than wide.

Metasoma (Fig. 23B). Relatively elongated and slender, shagreened, with very few scattered small granules. Colour dark yellow to orange, carinae darker. Segments I-IV with longitudinal dorsomedian furrow and with dorsal carinae composed of strong spiniform granules. Segments I-IV with lateral carinae developed as ridges bearing sparse spiniform granules, lateral carinae on segments III-IV less granular than those on segments I-II. Segments I-II with ventrolateral carinae developed as ridges with weak granules; segments III-IV with ventrolateral carinae as ridges of spiniform granules. Segment I-II with ventral carina a ridge with few very weak granules, almost smooth; segments III-IV with ventral carina a ridge with more distinct spiniform granules. Segment V: longitudinal dorsal furrow present in anterior half, dorsal carinae with strong spiniform granules; lateral carina vestigial, only visible in anterior 2/3 as a row of small scattered granules; ventrolateral and ventromedian carinae with spiniform granules.

Telson (Fig. 23B). Vesicle yellow to orange; aculeus darker, tan, due to stronger sclerotisation; vesicle elliptical or ovate, without blunt tuberculiform projections at base of aculeus; ventrolateral furrows and ventromedian ridge absent; lateral surfaces smooth, with sparse weak granules; dorsal surface with very small spiniform granules and a median shallow depression anteriorly. Macrosetae very sparse basally, becoming more numerous near base of aculeus. Aculeus short and stout, strongly curved, becoming markedly narrower approximately midway.

Chelicerae. Colour dark yellow; teeth of fingers darker, orange. Teeth arrangement as in Scorpionidae (see Vachon, 1963); fixed finger with median and basal teeth

bifid; movable finger with one subdistal tooth and one basal tooth in external series; distal external tooth smaller than distal internal tooth; cheliceral teeth without secondary serrations.

Pedipalp relatively elongated and slender. Pedipalp coxa and femur (Fig. 24D-F). Internoventral margin of coxa with few strong spiniform granules. Dorsal surface of femur predominantly dark yellow-orange, carinae darker, orange. Femur relatively short and stout (length less than 2.5 times its width), pentacarinata, with 4 distinct carinae; internodorsal carina developed as a strongly and densely granular ridge, spiniform granules strong; externodorsal carina developed as a ridge with spiniform granules; internoventral carina as a granular ridge with strong spiniform granules; externoventral carina as a ridge with spiniform granules; ventromedian carina reduced to few spiniform granules and confined to base of femur. Dorsal surface shagreened, finely and densely granular, distal end smooth, without granules; internal surface shagreened, with a few strong scattered spiniform granules; external surface shagreened; ventral surface shagreened and weakly granular, distal end without granules. A total of 3 trichobothria present on femur; *d* located externobasally on dorsal surface; *i* located dorsobasally on internal surface; *e* located dorsobasally on external surface. Pedipalp patella (Fig. 24D-F) relatively stout (length less than 2.5 times its width). Colour predominantly dark yellow to orange; carinae slightly darker. 7 carinae present, 6 of them distinct; internodorsal carina developed as a granular ridge; externodorsal carina as a ridge of indistinct granules; internoventral carina as a strongly granular ridge with spiniform granules; externoventral carina as a ridge of weak granules; externomedian carina as a weakly granular ridge. Dorsal surface shagreened, sparsely and weakly granular; internal and external surfaces shagreened; ventral surface shagreened, sparsely and weakly granular, distal end without granules. Internal protuberance pronounced, bifid (internodorsal and internoventral tubercles separated), internodorsal carina with 2 strong spiniform granules. A total of 19 trichobothria present on patella, orthobothriotaxy; *d*<sub>1</sub> located basally, external to internodorsal carina; *d*<sub>2</sub> located midway on patella; *d*<sub>3</sub> absent; *i* in distal half of patella, located dorsally on internal surface. External (*e*) trichobothrial groups discernible and orthobothriotaxic: *eb* group composed of 5 trichobothria, *esb* group of 2 trichobothria, *em* group of 2 trichobothria, *et* group of 3 trichobothria; *est* midway between *em* to *et* groups. Ventral (*v*) group of 3 trichobothria (orthobothriotaxic). Pedipalp chela manus (Fig. 24A-C). Colour predominantly orange to red-brown; carinae reddish brown to almost black. Chela relatively stout (length less than 2.5 times its width) with 5 distinct carinae; internodorsal carina continuous, with spiniform granules, stronger basally; subdigital carina vestigial, visible basally as a smooth ridge with weak granules; externodorsal carina distinct, visible as a ridge of indistinct fused granules, almost smooth; digital carina as a smooth ridge with few weak granules basally; dorsal secondary carina (dorsomedian) as a smooth ridge with very few strong granules basally and few weak granules distally; internoventral carina continuous, visible as a weak ridge with very weak granules; externoventral carina continuous, developed as a granular ridge, becoming almost smooth distally, running parallel to longitudinal axis of chela, its distal edge disconnected from external movable finger condyle and directed between external and internal movable finger condyles; ventromedian carina



vestigial, reduced to few coarse granules basally; internal (internomedian) carina vestigial, reduced to few weak spiniform granules in distal half; external (externomedian) carina indistinct, visible as raised rows of granules. Dorsal surface shagreened and sparsely granular; internal surface shagreened, sparsely granular, with a denser patch of bigger spiniform granules dorsodistally; external surface shagreened, sparsely and weakly granular; ventral surface shagreened and sparsely granular, distal end smooth and pitted. A total of 15 trichobothria present on chela manus; *Db* trichobothria located externobasally on dorsal surface; *Eb* group (3 trichobothria) orthobothriotaxic, located basally on external surface; *Esb* very close to *Eb* group; *Em* absent; *Est* located distally, very close to *Et* group; *Et* group composed of 5 trichobothria, *Et<sub>1</sub>* located ventrally; *V* group comprising 4 trichobothria, *V3* and *V4* located in basal third of manus, *V1* and *V2* located very far distally. Pedipalp chela fingers (Fig. 24A-C). Basally reddish tan, becoming gradually lighter distally, tips of fingers yellow, edges black. Dorsal and ventral surfaces predominantly smooth and pitted, slightly shagreened basally. Fingers slightly shorter than chela manus. Fixed finger with weak basal concavity, movable finger with corresponding lobe weakly developed. Tips of fingers with pronounced terminal hook. Fingers with distal diastema; edges of fingers composed of 2 rows of denticles becoming fused basally, interrupted at regular intervals by stronger granules, each of them coupled with an accessory granule; rows fused into a single row above concavity on fixed finger and on notch of movable finger, single basal row running towards base of fingers. A total of 11 trichobothria present on chelal fingers; *Dt* located very basally on dorsal surface; *db* located dorsally on internal surface, in the basal half of fixed finger; *dsb*, *dst* and *dt* on dorsal surface, in distal half of finger; *eb* located dorsally on external surface, in basal 1/3 of fixed finger, opposite *db*; *esb*, *est* and *et* in distal half of fixed finger, opposite *dsb*, *dst* and *dt*, respectively; *it* and *ib* located in median 1/3 of fixed finger.

Coxosternal sclerites. Dark yellow to orange; smooth, with shagreened patches. Anterior margin of coxapophysis I with few weak granules, expanded but not subtriangular in shape. Sternum of type 2 (Soleglad & Fet, 2003), longer than wide, pentagonal, slightly shagreened; median furrow deep, more pronounced in posterior half; posterior pit absent.

Legs. Pale yellow. Predominantly shagreened; ventral surface smooth; dorsal surfaces of trochanter and femur finely and weakly granular. Tarsus with a ventro-medial row of microspinules and with 2 rows of ventral rigid "spinoid" macrosetae; tarsi I-II: prolateral row with 4/5 macrosetae, retrolateral row with 5/6 macrosetae; tarsi III-IV: prolateral row with 5/6 macrosetae, retrolateral row with 6 macrosetae; setae acuminate; tarsal claws of equal length.

Pectines and genital operculum (Fig. 25). Dark yellow; genital operculum composed of 2 subtriangular plates; genital papillae short, not protruding from beneath operculum; pectines with 13/12 teeth.

Hemispermaphore. The presence of fully developed paraxial organs was assessed by cutting a small slit into the lateral pleural membrane between tergites and sternites. We did not have the permission to dissect the specimen.

*Intraspecific variation.* The other specimen examined, a subadult male, has pectines with 15-15 teeth.

*Remarks.* Apparently more male and female specimens of *H. persicus* from the type locality are lodged in the collections of the Zoological Institute of Saint Petersburg (Fet, pers. comm.) but unfortunately we could not get this material on loan.

## DISCUSSION

### TAXONOMIC CHARACTERS

*Sexual dimorphism.* Apart from *H. persicus*, all Iranian species of the genus *Hemiscorpius* show a pronounced sexual dimorphism: mature males have a distinctly more elongated metasoma and telson than females (subadult males do not exhibit this sexual dimorphism) (Figs 4, 27). In *H. acanthocercus* sp. n., *H. enischnochela* sp. n., *H. lepturus* and probably also in *H. gaillardi* this dimorphism reaches extreme levels. Among scorpions extreme elongation of the metasoma in males is fairly common. It is encountered in the buthid genera *Centruroides*, *Compsobuthus* and *Isometrus*, as well as in genera belonging to families that are closely related to Hemiscorpiidae, i. e. *Hadogenes* Kraepelin, 1894 (Liochelidae), *Heteroscorpion* Birula, 1903 (Heteroscorpionidae) and *Urodacus* Peters, 1862 (Urodacidae).

*Hadogenes* spp. are ultralithophilous scorpions occurring in the Afrotropical region. They inhabit weathered rock outcrops where their extremely flattened morphology allows them to creep into narrow crevices and fissures. The very long tails of the males of most *Hadogenes* species are an essential adaptation to this specialized environment. During courtship the male usually stings the female in the pleural membrane between the sternites and tergites. This behaviour is known as sexual sting. In very narrow cracks where courtship usually takes place, the male must reach around the side of the female's body to sting her (Leeming, 2003).

The endemic Malagasy genus *Heteroscorpion* is closely related to the Urodacidae. As in *Hadogenes*, the four known *Heteroscorpion* species are well adapted to live in rocky habitats and occur in narrow fissures between layers of splintered but still standing rocks. The metasoma of males is also very elongated compared to females (Lourenço & Goodman, 2002, 2004; Lourenço *et al.*, 2004). However, these scorpions do not show an extreme dorsoventral depression of the body as in *Hadogenes*.

On the other hand, scorpions of the genus *Urodacus* are mostly burrowers, therefore they are usually very stocky. However, males of four species, i. e. *U. elongatus* L.E. Koch, 1977, *U. megamastigus* L.E. Koch, 1977, *U. mckenziei* Volschenk, Smith & Harvey, 2000 and *U. varians* Glauert, 1963, show an extreme elongation of their metasoma (L. E. Koch, 1977; Volschenk *et al.*, 2000) but they are not strictly lithophilous. *U. varians* is a burrowing species and the others excavate shallow scrapes under stones and are sometimes found in rock crevices (Volschenk, pers. com.). Ecomorphological adaptations to rocky habitats also occur in the scorpionid genus *Opisthophthalmus* C.L. Koch, 1837, which is mostly composed of burrowing species (Prendini, 2001). Because of soil hardness in their habitats, *O. austerus* Karsch, 1879, *O. karoensis* Purcell, 1898 and *O. pattisoni* Purcell, 1899 have abandoned burrow construction in favour of a semi-lithophilous existence under slabs of rock. All these species display morphological adaptations similar to those in *Hadogenes*, i. e. dorsoventral depression of the body and greatly elongated pedipalpal chelae.

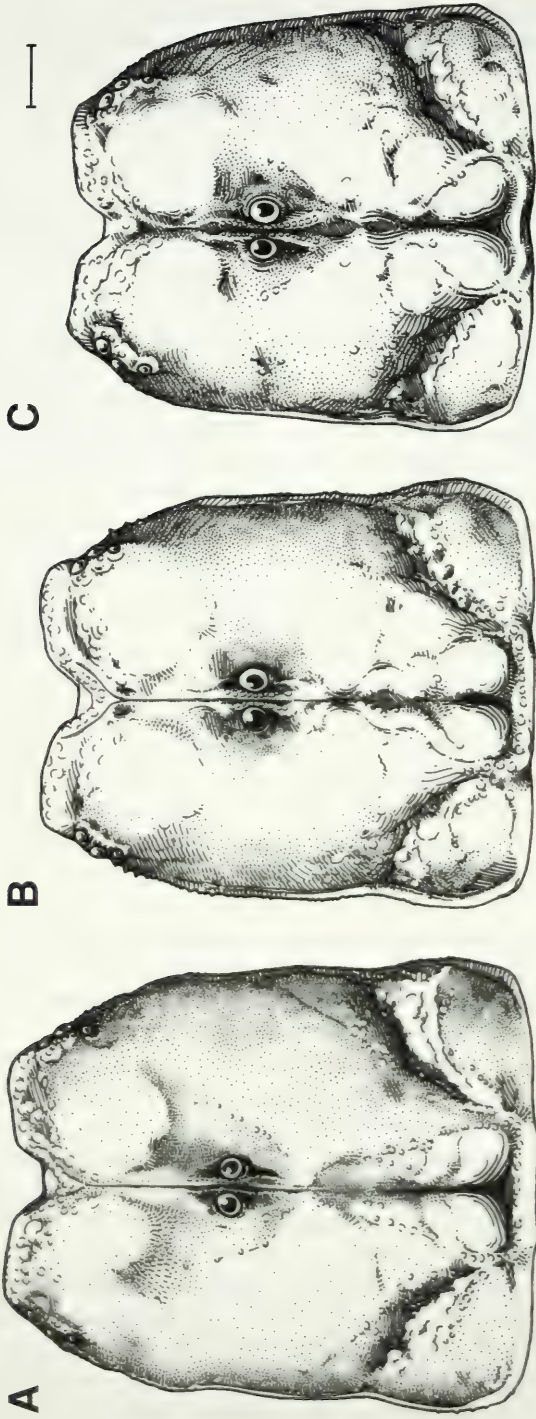


FIG. 26

*Hemiscorpius* spp., carapace, dorsal aspect. *Hemiscorpius enischnochela* sp. n.: A, male holotype; B, female paratype (NHMW 76). *H. gaillardi*: C, female holotype. Scale line, 1 mm.



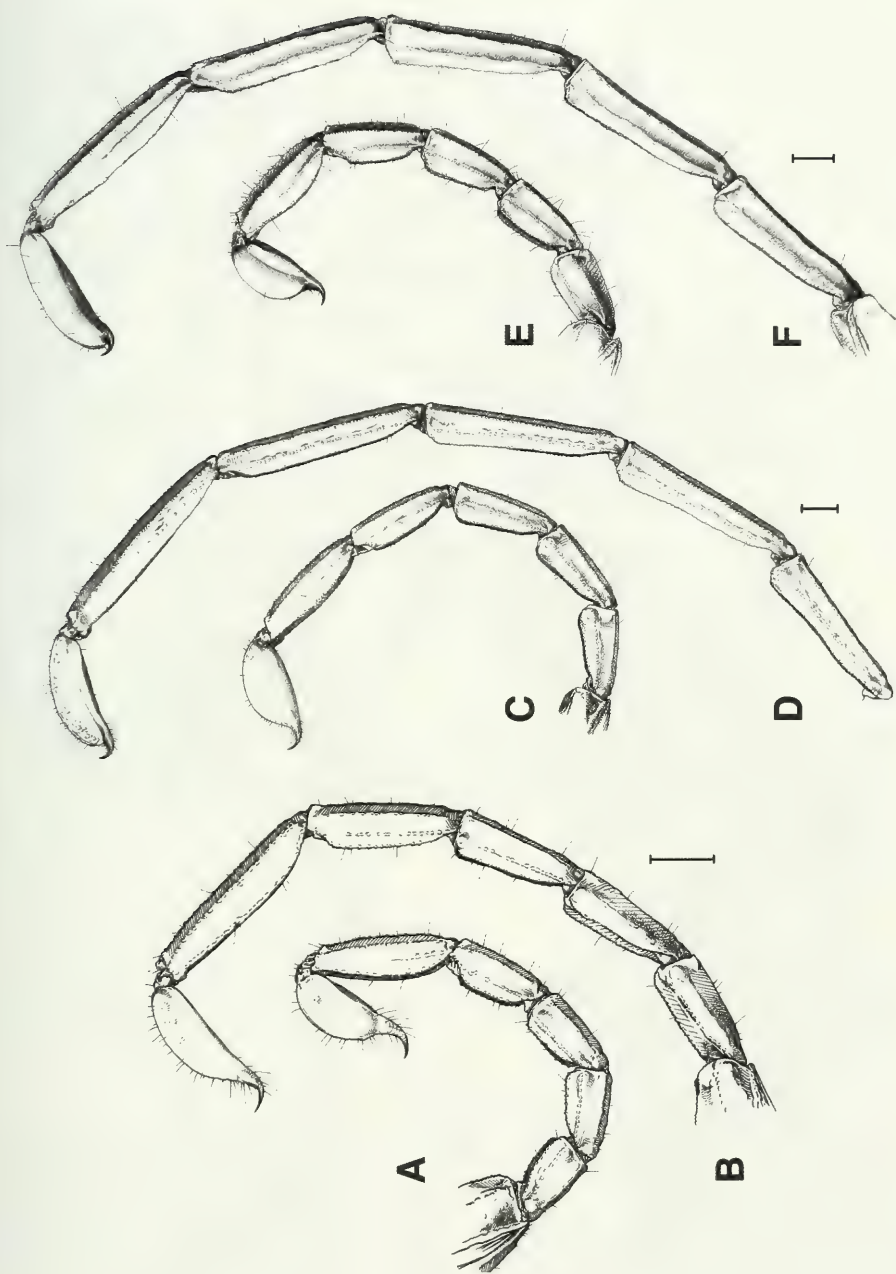


FIG. 27

*Hemiscorpius* spp., metasoma, lateral aspect. *Hemiscorpius maindroni*: A, female syntype; B, male syntype. *Hemiscorpius enischnochela* sp. n.: C, female paratype (MNHG, Masdyed-Soleyman); D, male holotype. *Hemiscorpius lepturus*: E, female (MNHN, Ahwaz); F, male (MNHN-RS 5232). Scale lines, 2 mm.

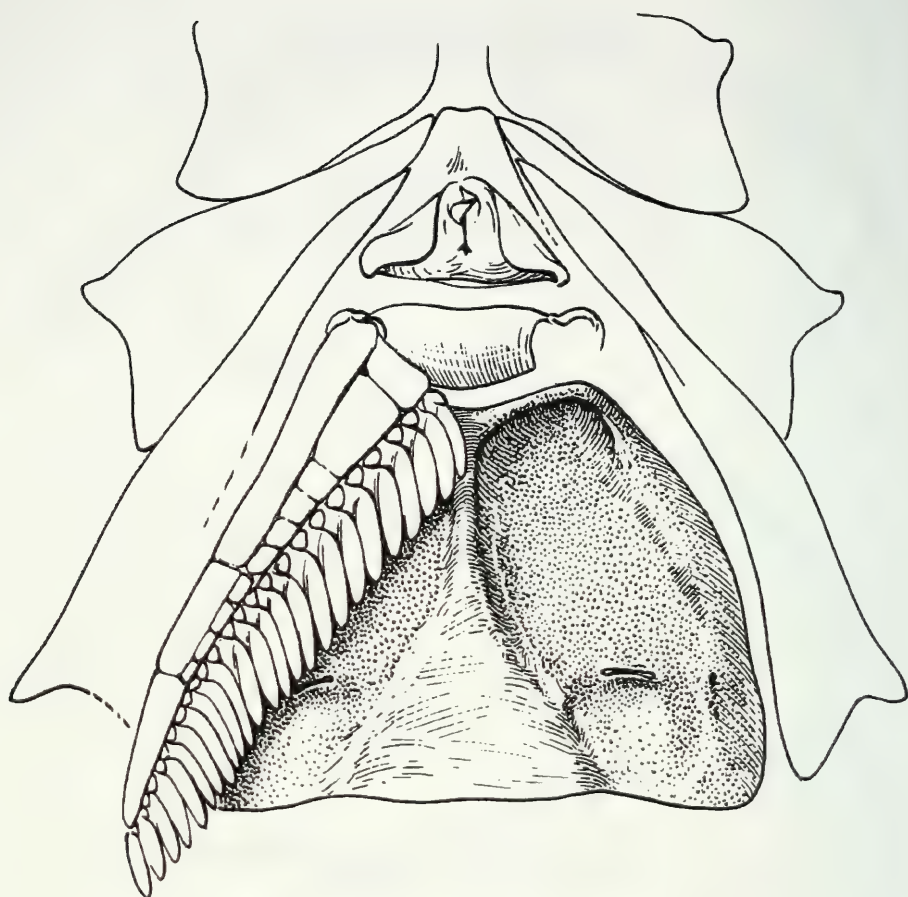


Fig. 28

*Rhopalurus agamemnon* (C. L. Koch, 1839), male, ventral view of central part of body with left pecten removed showing the granular depressed region of the third sternite III (from Lourenço & Cloudsley-Thompson, 1995).

There is no information on the labels of the specimens studied referring to collecting methods, ecology, or habitat. However, the rugged, mountainous topography of their environment and their morphology, i. e. strongly elongated metasoma and dorsoventral depression of the body, indicate that Iranian Hemiscorpidae are lithophilous species. Lithophilous scorpions adapted to live in narrow cracks and crevices of rocks are characterized by the following features: (1) dorsoventral depression of the body; (2) elongation of the metasoma and/or pedipalps; (3) spiniform macrosetae on the telotarsi, operating in conjunction with highly curved telotarsal ungues to provide grip on rock surfaces (Prendini, 2001). All these adaptations are present in hemiscorpids.

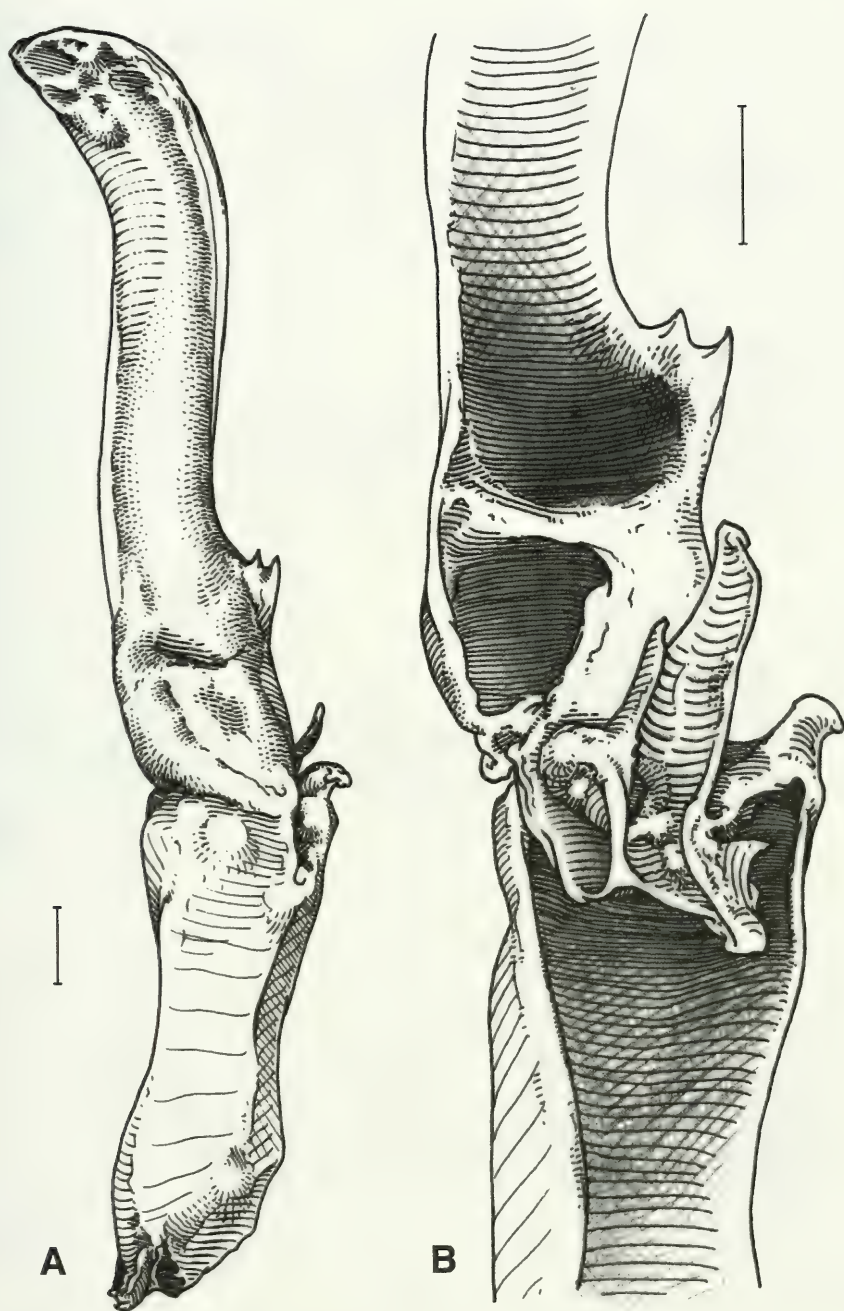


FIG. 29

*Hemiscorpius maindroni*, male syntype (MNHN-RS 4328), hemispermatophore: A, hemispermatophore in toto; B, detail of the capsular region, internal aspect. Scale lines, 0.25 mm.



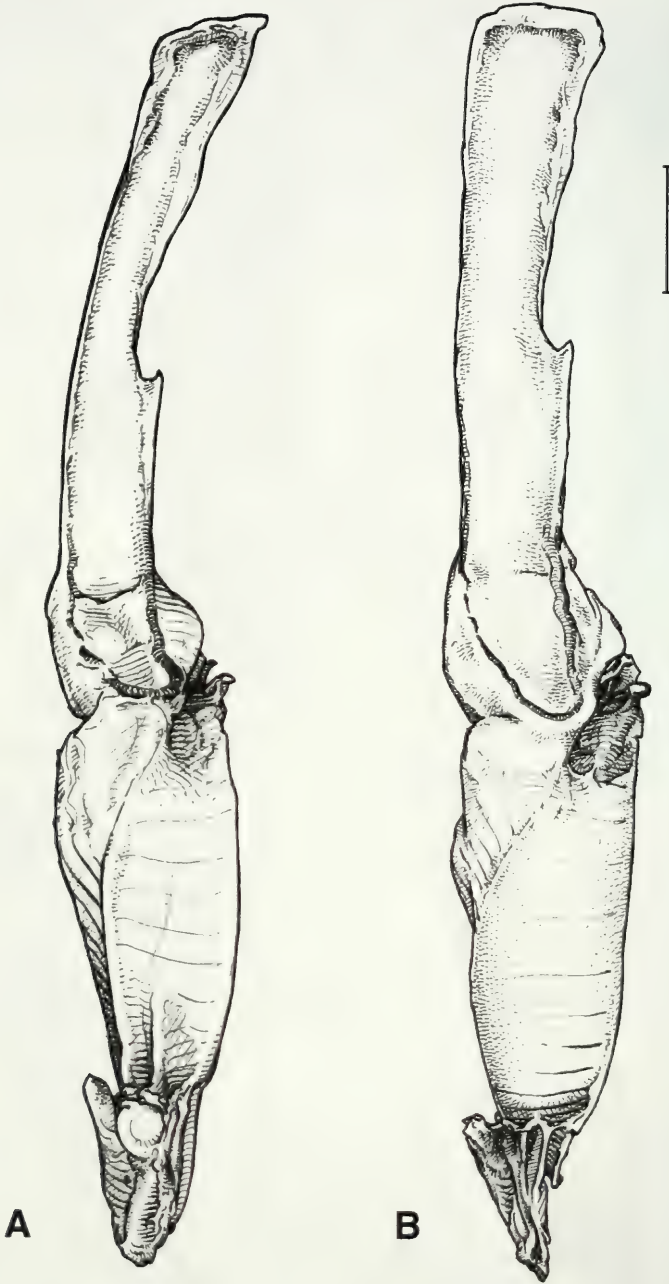


FIG. 30

*Iomachus politus*, hemispermatothores of two males, external aspect: A, male from German East Africa, now TANZANIA (NHMW 1733); B, male from Handeni, Tanganyika, TANZANIA (CAS). Scale line, 1 mm.

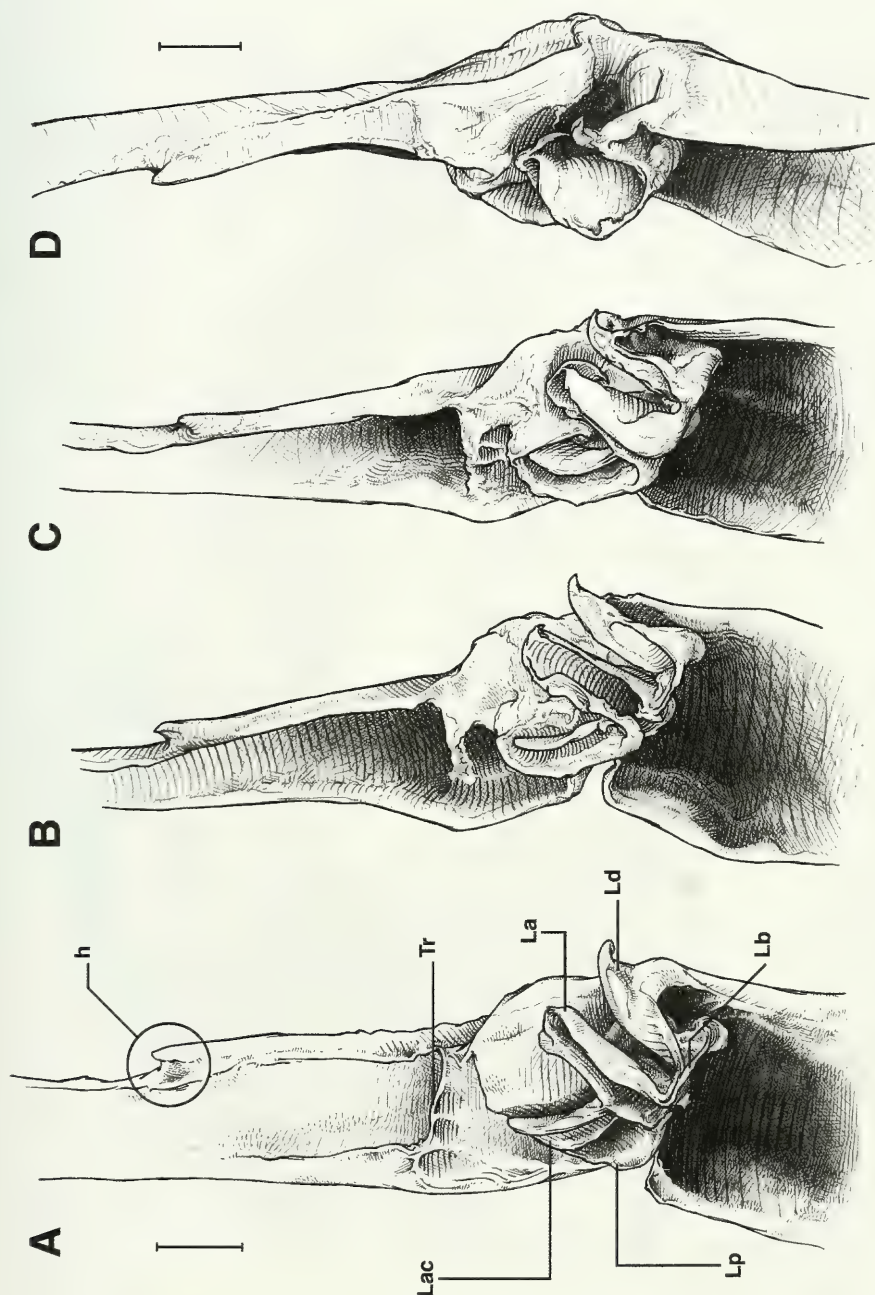


FIG. 31

*Iomachus politus*, hemispermatophores of two male, detail of the capsular region, internal aspect, h (hook), La (lamella), Lac (accessory lobe), Lb (basal lobe), Ld (distal lobe), Lp (posterior lobe), Tr (transverse ridge): A, male from Handeni, Tanganyika, TANZANIA (CAS); B-D, male from German East Africa, now TANZANIA (NHMW 1733). Scale line, 0.5 mm.

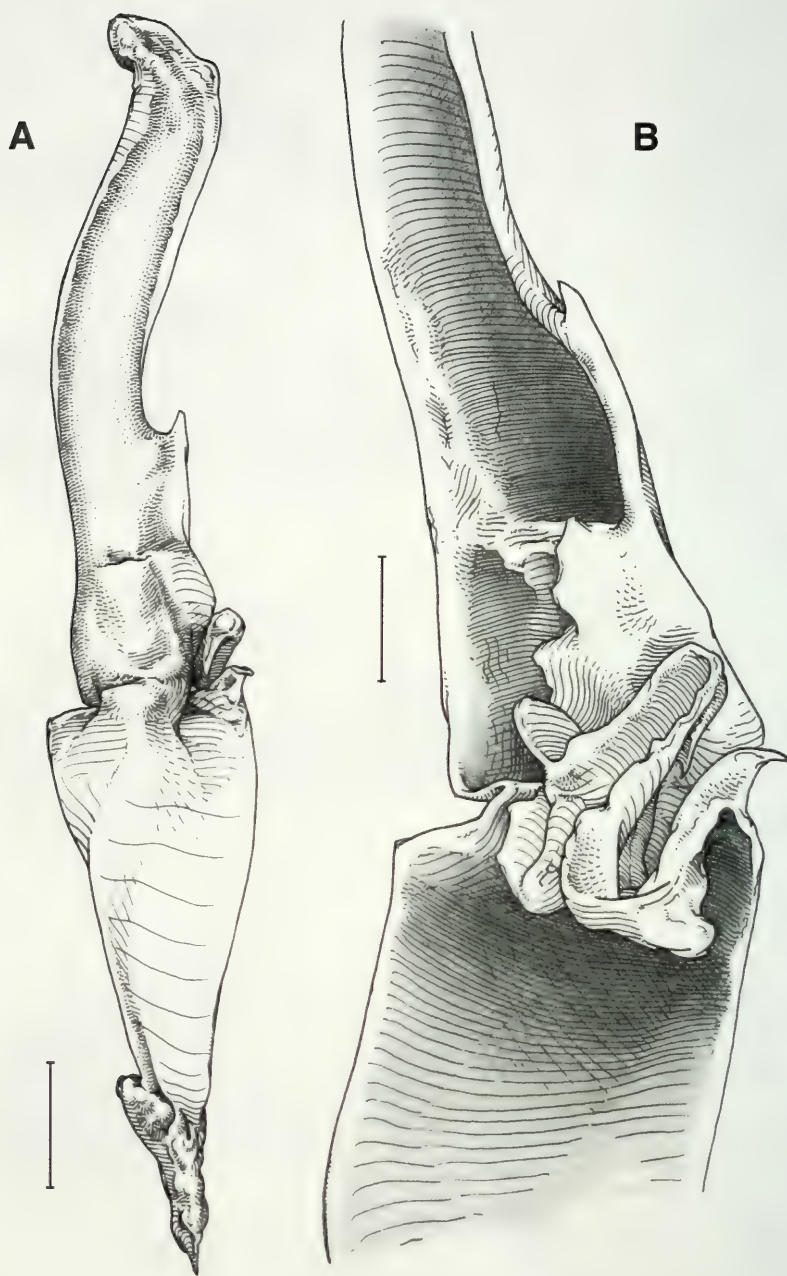


FIG. 32

*Opisthacanthus lecomtei*, male (MNHN-RS 6264, Belinga, GABON), hemispermatophore: A, hemispermatophore in toto (scale line, 1 mm); B, detail of the capsular region, internal aspect (scale line, 0.5 mm).



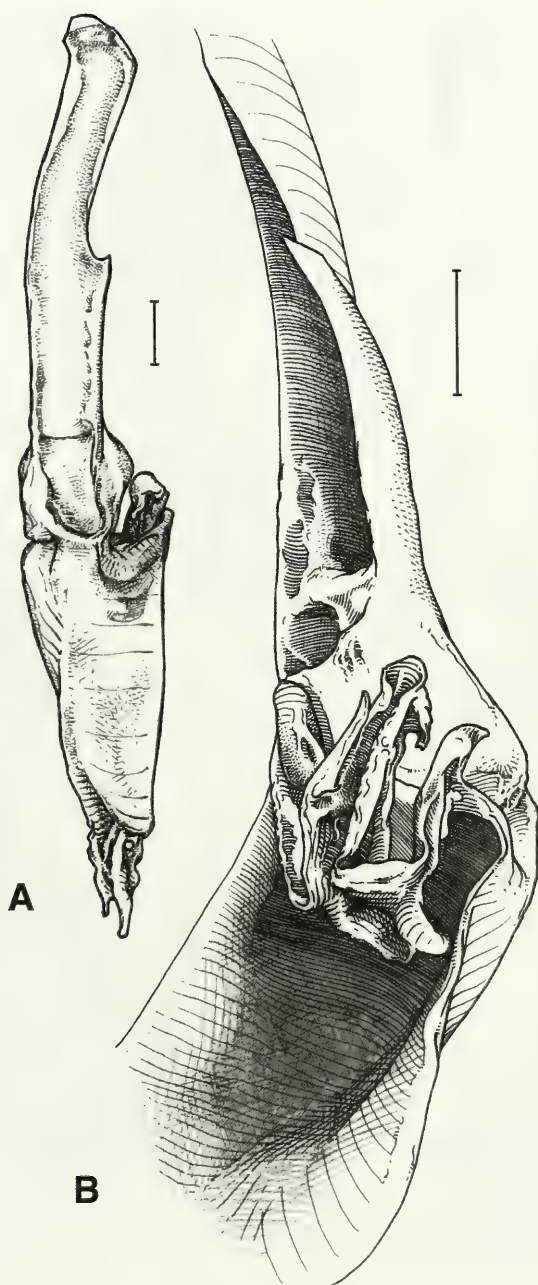


FIG. 33

*Opisthacanthus cayaporum* Vellard, 1932, male (MHNG, Campos de Cayapos, BRASIL), hemispermatophore: A, hemispermatophore in toto; B, detail of the capsular region, internal aspect. Scale lines, 1 mm.

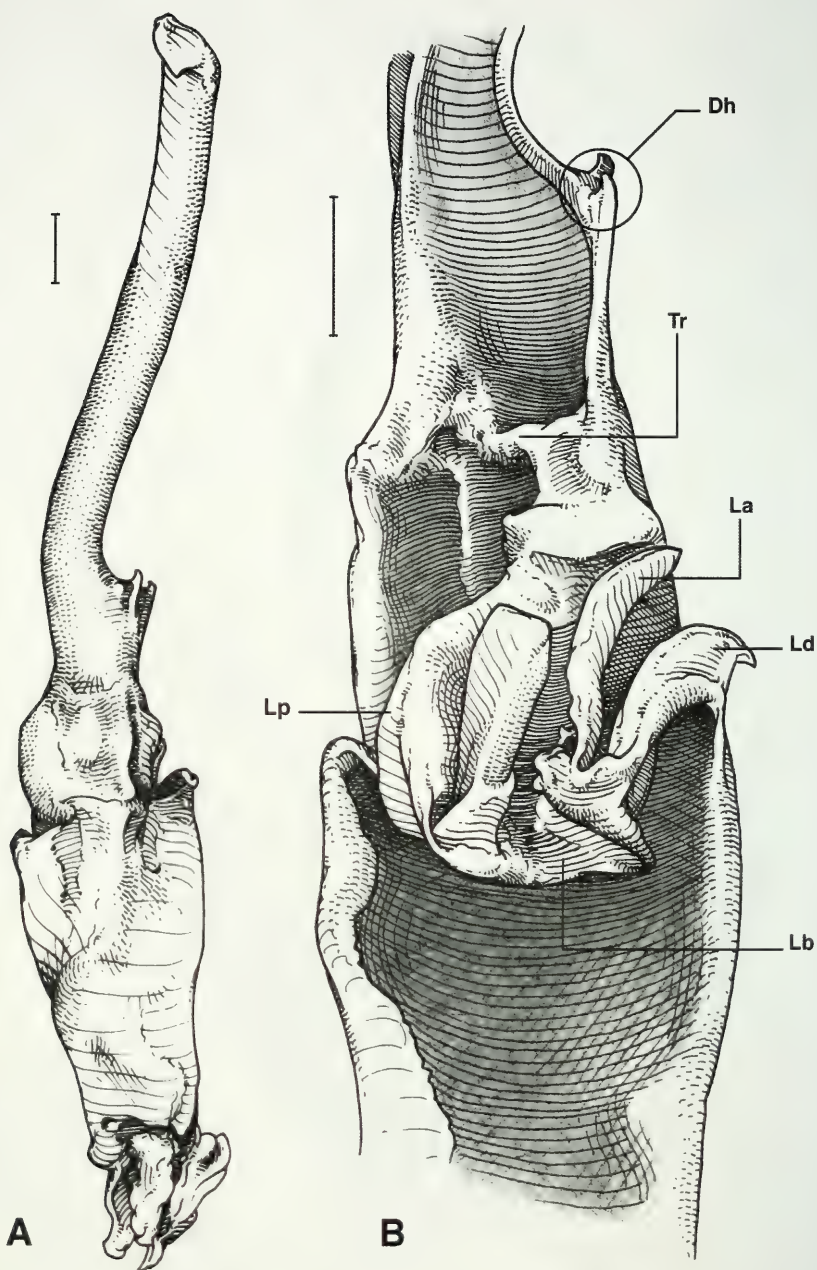


FIG. 34

*Hadogenes troglodytes* (Peters, 1861b), male (NHMW 1703, South Rhodesia, now ZIMBABWE), hemispermaphore: A, hemispermaphore with in toto; B, detail of the capsular region, internal aspect, Dh (double hook), La (lamella), Lb (basal lobe), Ld (distal lobe), Lp (posterior lobe), Tr (transverse ridge). Scale line, 1 mm.

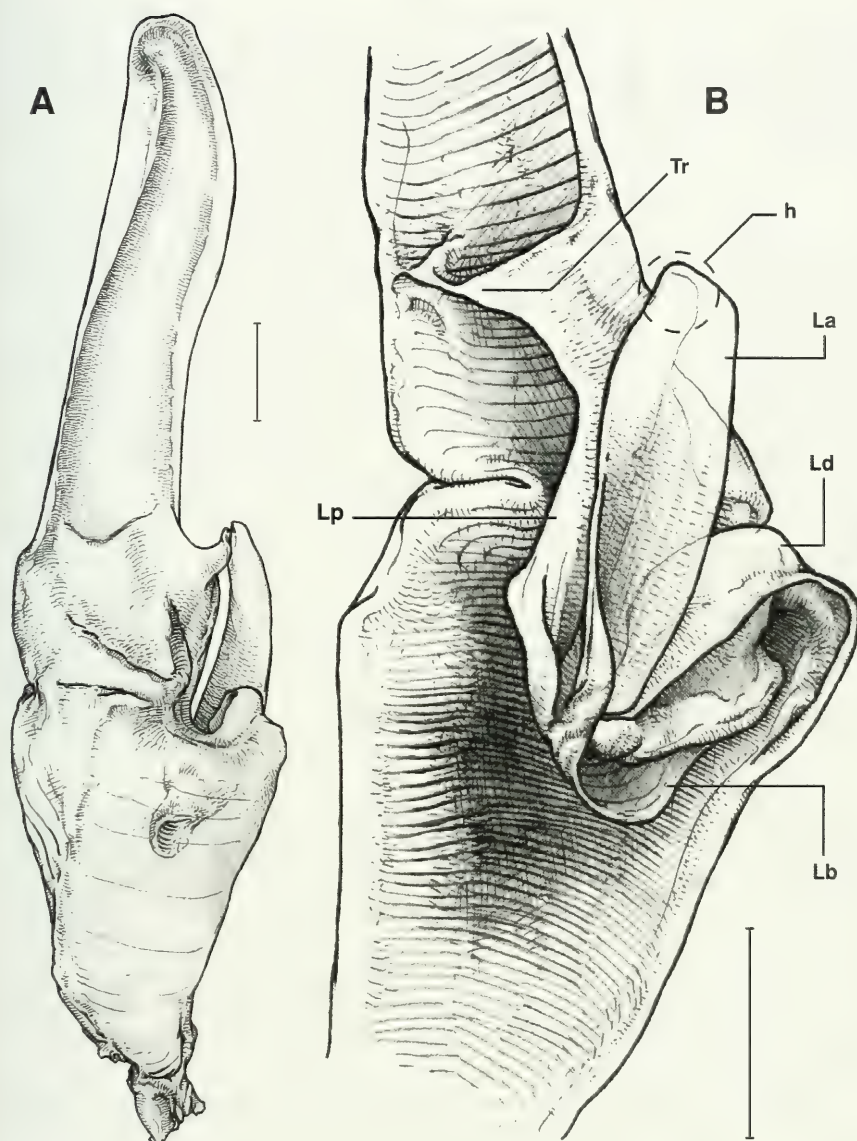


FIG. 35

*Liocheles australasiae* (Fabricius, 1775), male (BPBM, Tanna Island, VANUATU), hemispermatophore: A, hemispermatophore in toto; B, detail of the capsular region, internal aspect, h (hook), La (lamella), Lb (basal lobe), Ld (distal lobe), Lp (posterior lobe), Tr (transverse ridge). Scale lines, 0.5 mm.

In male hemiscorpiids the genital operculum is composed of two overlapping plates, whereas in females it is a single undivided plate. Like in other scorpions, males have bigger pectines with a higher pectinal teeth count than in females. In the *H. lepturus* species group the carapace is usually more elongated in males (longer than wide)



than in females (almost as wide as long) (Fig. 26). Likewise, tergites and sternites VII are longer than wide in males, while as wide as long in females. Like the dimorphism in metasoma length, this difference is present only in the final instar. Immature males and females look much the same and can usually be distinguished only through examination of their genital operculum and pectines.

*Granular depressions on sternites III.* In males and females of *Hemiscorpius acanthocercus* sp. n., *H. enischnochela* sp. n., *H. gaillardi*, *H. lepturus* and *H. persicus*, the foremost sternite exhibits a pair of large, rough, very finely granular depressions. This feature is morphologically very similar to the stridulatory apparatus of species belonging to the neotropical buthid genus *Rhopalurus* (Fig. 28). The *Rhopalurus* stridulatory apparatus consists of large granular areas on the third sternite, which are located under the pectines and are used as a rasp. Pectinal teeth with striations on their dorsal surface are rubbed against these areas in order to produce sound. Stridulation have been reported for all *Rhopalurus* species (in both males and females), but only the stridulatory sounds of larger species are audible to humans (Lourenço & Cloudsley-Thompson, 1995; Lourenço, Huber & Cloudsley-Thompson, 2000). Production of stridulatory sound has never been reported for any *Hemiscorpius* species, but this can be attributed to the small or medium size of these scorpions (regardless of the length of the metasoma), which probably produce barely audible sounds. The dorsal surfaces of their pectinal teeth seem to be finely granular. However, this character could not be assessed accurately because of the very reduced size of the structures. More thorough investigations by means of a stereo-electron microscope are needed.

*Hemispermatothores.* The hemispermatothores of Hemiscorpiidae (Figs 7, 20, 21, 29) share morphological similarities with hemispermatothores of *Hadogenes* species (Fig. 34) and of a liochelid group composed of *Iomachus politus* (Fig. 30-31) and *Opisthacanthus* (*Opisthacanthus*) species (Figs 32, 33). The general shape of hemispermatothores is the same in these taxa, i. e. distal lamella longer than the basal part, lamellar hook situated above the distal transverse ridge and not merging with it. However, Hemiscorpiidae have hemispermatothores with the distal lamella bearing a double hook, whereas all the other liochelid genera except *Hadogenes* have distal lamellae with a single hook.

The capsular median structure of hemiscorpiid hemispermatothores is complex (Figs 7B-C, 21A-C, 29B), composed of 4 distinct lobes/lamellae: (1) capsule lamella (La) complex, bearing a strong hook on his external surface and an accessory lobe (Lac) pointing to the posterior side, (2) distal lobe (Ld) forming a strong hook pointing anteriorad, (3) basal lobe (Lb) very reduced, (4) posterior lobe (Lp) costate. *Iomachus politus* and *Opisthacanthus* (*Opisthacanthus*) species (both African and neotropical representatives) possess hemispermatothores (Figs 30-33) very similar to those encounter in hemiscorpiids, i. e. with distal lobe with a strong hook pointing anteriorly and with a complicated capsular lamella bearing an internal hook and an additional basal lobe. In *Hadogenes* (Fig. 34) and other liochelid genera the capsule lamella is much more simple, without any hook or accessory lobe. In *Liocheles* Sundevall, 1833

the distal lobe is not modified into a large hook and the basal lobe is much more developed (Fig. 35).

Based on this analysis *Hadogenes* and the group composed of *Iomachus politus* and *Opisthacanthus* (*Opisthacanthus*) spp. are considered to be liochelid taxa closely related to hemiscorpiids. The double lamellar hook can therefore be considered as a plesiomorphy for Hemiscorpiidae and Liochelidae, and the single lamellar hook is apomorphic for all Liochelidae except *Hadogenes*. On the other hand, the complex capsule lamella can also be considered as a plesiomorphy for Hemiscorpiidae and Liochelidae. However, the derived, more simple structure examined in *Hadogenes* and other liochelid genera (e. g., *Liocheles*) is assumed to have evolved independently in these two groups.

#### BIOGEOGRAPHICAL AND GEOLOGICAL IMPLICATIONS

*Iomachus politus* occurs in East Africa (Ethiopia, Kenya Tanzania, Uganda) and the only African representative of the subgenus *Opisthacanthus*, *O. (O.) lecomtei* (Lucas, 1858), was recorded from approximately the same latitude in West Africa (Cameroon, Gabon). The neotropical species of *Opisthacanthus* (*O.*) are found in Central and South America and *Hadogenes* is a South African genus. *Hemiscorpius* is present all over the Middle East (Iran, Iraq, Oman, Pakistan, Saudi Arabia, United Arab Emirates and Yemen), but has also some representatives in north-eastern Africa (Djibouti, Eritrea, Somalia), not far from the distribution area of *Iomachus politus*. The presence of Hemiscorpiidae in Djibouti, Eritrea, Somalia, and on the island of Socotra indicates that the ancestor of *Hemiscorpius* was probably present on Gondwanaland.

Since Hemiscorpiidae is the sister group of Liochelidae and *Hemiscorpius* shares characters with certain African liochelids, i. e. *Iomachus politus* and *Opisthacanthus* (*O.*) *lecomtei*, the occurrence of *Hemiscorpius* in Africa is probably due to a Gondwanian origin and not a recent invasion from the Middle East (Laurasia). However, the Iranian *Hemiscorpius*, i. e. the *H. lepturus* species group, are very divergent from the *Hemiscorpius* species from Africa, Oman, Saudi Arabia, United Arab Emirates and Yemen. The African species of *Hemiscorpius* do not show the highly derived features that their Iranian relatives possess, i. e. extreme sexual dimorphism and cytotoxic venom. Iranian *Hemiscorpius* have probably been separated from the other hemiscorpiids for quite a long time. *H. persicus* represents an exception among Iranian *Hemiscorpius*; this species is more similar morphologically to African and Arabian representatives of the genus than to the Iranian ones. This could be the result of a more recent invasion from the Arabian peninsula.

An old separation of the Iranian hemiscorpiids can be explained by the geological history of the region. In the Precambrian and Palaeozoic the Cimmerian terrane, which included Iran, was part of Gondwana (Fig. 37, 38A). The common ancestor of Liochelidae and Hemiscorpiidae was probably widespread on this super-continent. Approximately 250 Ma BP (Fig. 38B) the Neotethys ocean started to open (Golonka, 2000; Scotese, 2000; Stampfli & Borel, 2002), inducing the rift of the Cimmerian super terrane off the northern margin of Gondwana and its northward drift toward Laurasia. Iran was separated from Gondwana in the Middle Triassic. The ancestor population of the Middle East hemiscorpiids was probably isolated on this rafting continent and diverged from its relatives.

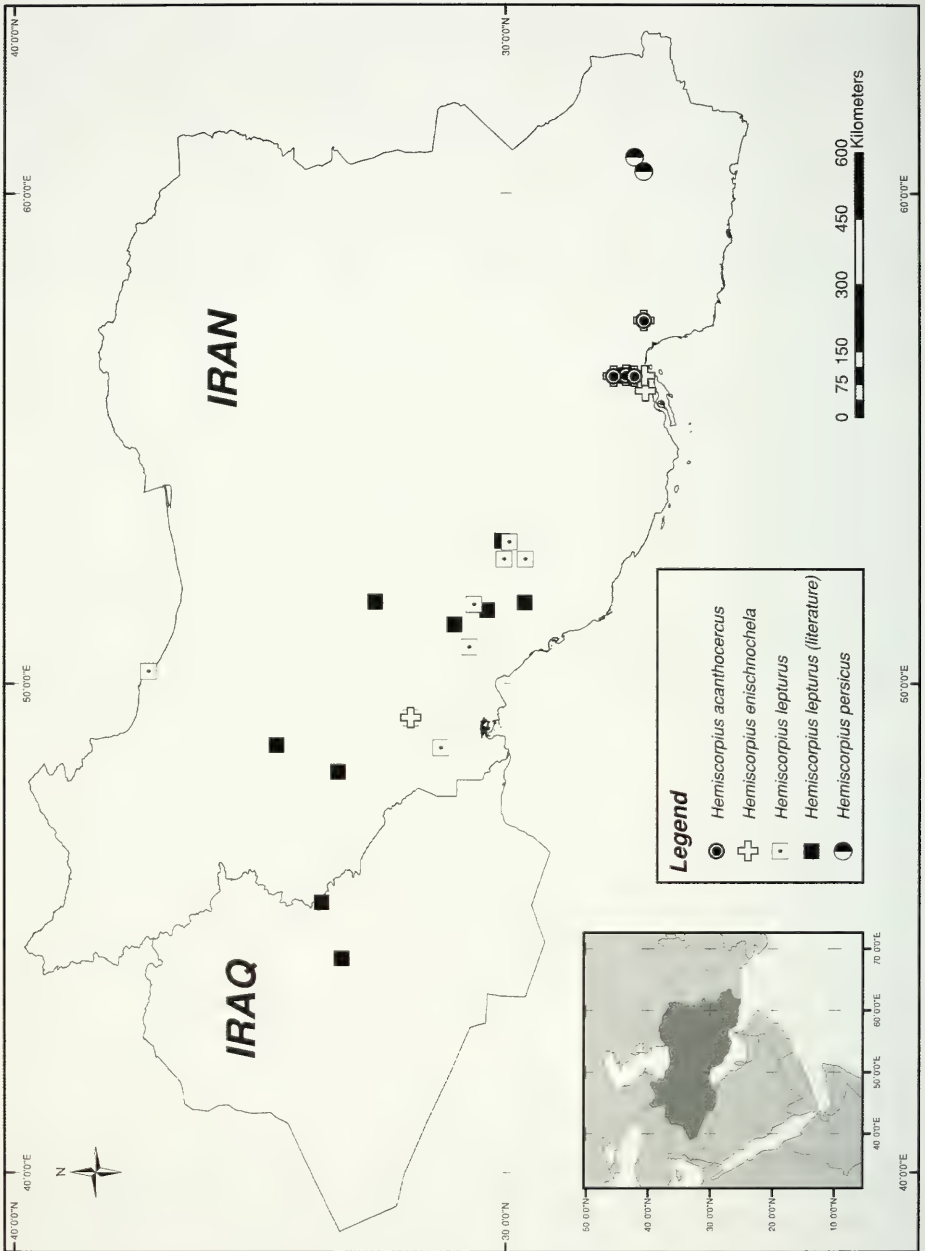


FIG. 36  
Distribution map of *Hemiscorpius* spp. In Iran and Iraq.





FIG. 37

Palaeogeographic reconstruction of the Earth during the late Permian (269-248 Ma BP). Landmasses are indicated by grey shading. The Neotethys started to open, inducing the rifting of the Cimmerian Superterrane from Gondwana. Modified from Golonka, 2000.

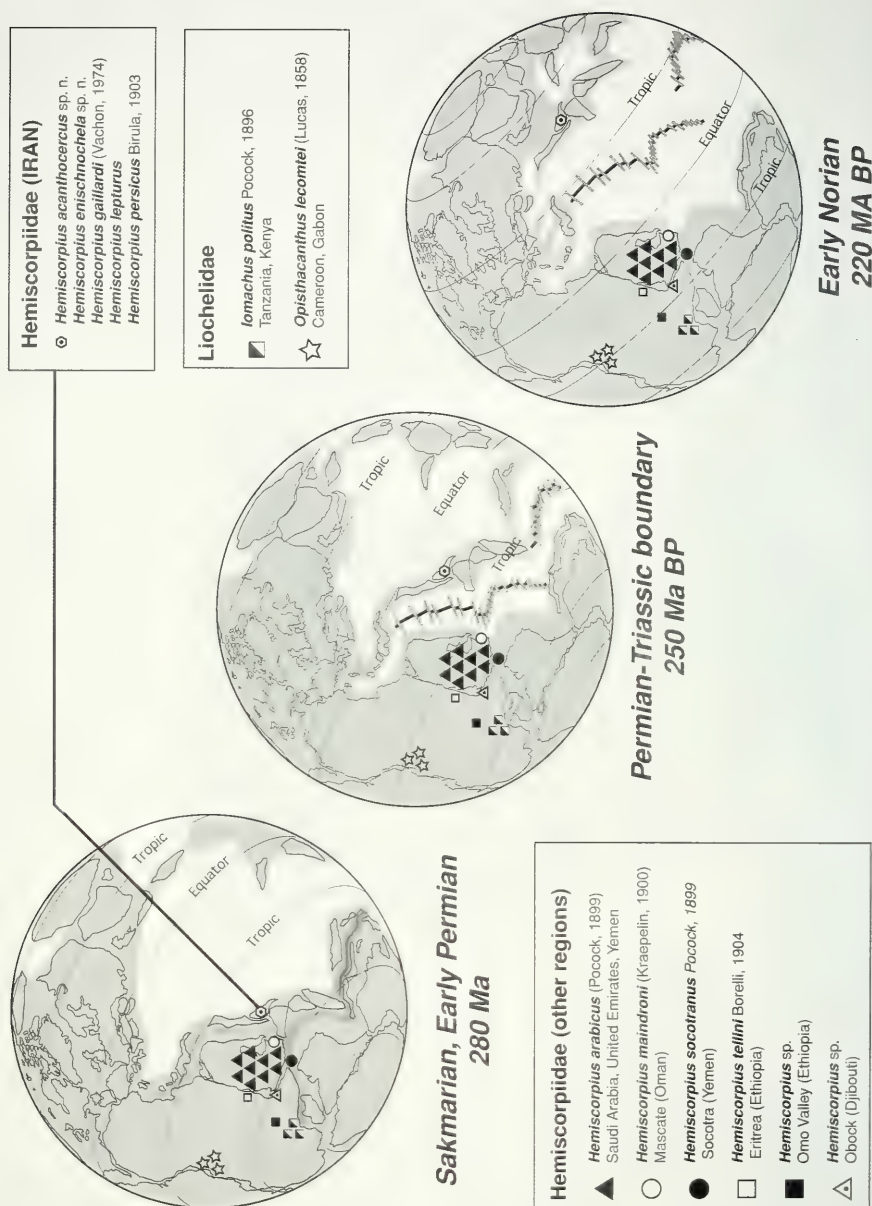


FIG. 38

Palaeogeographic reconstructions of the Tethys Oceans and surrounding landmasses 280, 250 and 220 Ma BP. The opening of the Neotethys separated the Cimmerian Superterrane from Gondwana, inducing the Cimmerian Terrane to drift toward Eurasia. Its accretion to Laurasia occurred 220 Ma BP when the oceanic crust of the Palaeotethys was completely subducted to the north. Landmasses are indicated by grey shading and current distribution areas of Hemiscorpiidae and related Liochelidae are indicated by pictograms. Positions of equator and tropics are also shown. Modified from Stampfli & Borel, 2002.

The Hemiscorpiidae lineage was supposedly separated from the Liochelidae lineage before the rifting of the Cimmerian terrane, probably by climatic changes on Gondwana that occurred during the massive Permian global warming (290-250 Ma BP; Rees, 2002). Four main terrestrial climate zones (biomes) have been determined from fossil floras and climate-sensitive sedimentary rocks for the Late Carboniferous-Early Permian (300-280 Ma BP) (Gibbs *et al.*, 2002; Rees *et al.*, 1999; Rees *et al.*, 2002; Scotese, 2000; Willis & McElwain, 2002). In both hemispheres, climates gradually changed from the equator to the poles as follow: (1) tropical everwet (equatorial region), (2) subtropical desert, (3) cool temperate and (4) cold (polar region). At that time Gondwana was situated south of the equator and was therefore under mostly lush and green vegetation (cool temperate), except for its north-eastern part where arid conditions prevailed (subtropical desert). Throughout the Permian, the climate change from icehouse to hothouse conditions (Rees, 2002). With global warming and increasing aridity, tropical forests disappeared and cool temperate biotopes were segregated in the southern part of Gondwana as deserts spread across central Pangea; tropical everwet biomes were only well-developed on the Chinese microcontinent (Rees, 2002; Scotese, 2000). Therefore the hemiscorpiid ancestor adapted to an environment (in Africa and Arabia) that became more and more arid during the Permian, while liochelids remained in the more humid and cool ecosystems prevailing in the southern part of Gondwana (Scotese, 2000; Willis & McElwain, 2002). By the Late Triassic-Early Jurassic (210-200 Ma BP), large subtropical deserts formed a climatic barrier (Rees, 2002; Rees *et al.*, 1999) between the liochelid ancestor in warm temperate forests of Southern Gondwana and the African hemiscorpiid ancestor in the Equatorial summerwet biotopes of the Arabian region, and interrupted gene flow between these two lineages. Most of the modern scorpion families probably emerged at the end of the Palaeozoic Era, when changing biomes, high rates of extinction and the resulting isolation of surviving populations in scattered "biotopes islands" were favourable for diversification.

After being detached from North and South America, Africa began to rotate counterclockwise toward Eurasia and closed the western part of the formerly extensive Neotethys sea (Brown & Lomolino, 1998; Golonka, 2000). A bridge between Asia and Africa was formed by Arabia, following their collision in the middle Tertiary (35 Ma BP) that created the Zagros mountains of Iran. Then hemiscorpiids could have easily established new colonies through dispersal from the Arabian peninsula to Eurasia. Another hypothesis is the drift of microcontinents from the northern margin of Gondwana towards the southern margin of Laurasia during the last 200 million years, scorpions could have been carried on them to Eurasia.

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**New genera and species of nematode parasites (Drilonematoidea: Ungellidae) from coelomic cavity of Neotropic acanthodrilids deposited in the Natural History Museum of Geneva, Switzerland**

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**New genera and species of nematode parasites (Drilonematoidea: Ungellidae) from coelomic cavity of Neotropic acanthodrilids deposited in the Natural History Museum of Geneva, Switzerland.** - Two new genera and two new species of nematodes (Ungellidae, Drilonematoidea) parasitic in Neotropic acanthodrilids from the collection of the Natural History Museum of Geneva, Switzerland, are described. *Yagansiella longicollis* gen. n., sp. n. and *Ungella chileana* sp. n. are parasitic in *Yagansia spatulifera*, whereas *Ungella micronychium* sp. n. in *Y. diversicolor* and *Patagoniella capitoporus* gen. n., sp. n. in *Y. papillosa*. *Yagansiella longicollis* gen. n., sp. n. resembles *Ungella* in general morphology but differs by anterior position of ovary top cell and posterior vulva position, characteristic body and caudal fimbriate organs shape. *U. chileana* sp. n. is distinguished by large circular fimbriate organs in tail, female body shape and arrangement of female genital tube and spicule shape. *Ungella micronychium* sp. n. differs by minute cephalic hooks and shape of fimbriate organs and spicules and gubernaculum. *Patagoniella capitoporus* gen. n., sp. n. is distinguished by anteriormost position of excretory pore, anterior vulva position and shape of fimbriate organs and spicules and gubernaculum.

**Keywords:** Earthworms, nematode parasites - Ungellidae - Drilonematoidea - *Yagansiella longicollis* gen. n., sp. n. - *Ungella chileana* sp. n. - *Ungella micronychium* sp. n. - *Patagoniella capitoporus* gen. n., sp. n. - *Yagansia spatulifera* - *Yagansia diversicolor* - *Yagansia papillosa*.

## INTRODUCTION

Earthworm collection deposited in the Natural History Museum of Geneva contains European lumbricids as well as annelids from around the globe. From 1 to 6 specimens of 142 species of earthworms from museum collection were studied on the presence of nematodes (Drilonematoidea, Rhabditida) parasitic in coelomic cavity of earthworms. The bulk of museum collection consists of Neotropic glossoscolecids and acanthodrilids. So far, the only drilonematid parasite had been recorded from these



earthworms. A new genus and the new *Ungella* species from coelomic cavity of *Yagansia spatulifera*, the new *Ungella* species from *Y. diversicolor* and the new genus from *Y. papillosa* all belonged to Ungellidae family are described below.

## MATERIAL AND METHODS

Earthworms were stored in ethanol after formaldehyde fixation which found did not affect the nematode morphology. Earthworms were dissected at anterior end and body cavity content was rinsed out and nematode parasites removed. Four specimens of *Yagansia spatulifera*, six ones of *Y. diversicolor* and three of *Y. papillosa* were dissected. Three females and three males of *Yagansiella longicollis* gen. n., sp. n. and a male and a female of *Ungella chilleana* sp. n. were obtained from coelomic cavity of single specimen of *Yagansia spatulifera*. Two males of *U. micronychium* sp. n. were recovered from a specimen of *Y. diversicolor* and nine males, five females, three juveniles and fragments of *Patagoniella capitoporum* gen. n., sp. n. from a specimen of *Y. papillosa*. Nematodes were processed into glycerol using slow evaporation technique (Seinhorst, 1959) and mounted on slides. Drawings and measurements were made using "Jenaval" microscope. De Manian indices and absolute measurements are given, where D is maximal diameter (if not indicated), Oes is oesophagus length, Cd is tail length and Ex is distance from base of cephalic hooks to excretory pore. A name "fimbriate organs" was used when describing caudal structures of sensory nature (phasmids?) instead of "suckers" (Ivanova & Hope, 2004).

## DESCRIPTIONS

### *Yagansiella* gen. n.

DIAGNOSIS. Rhabditida, Drilonematoidea, Ungellidae. Very long and thin neck region and swollen body. Spacious pseudocoel. Paired blade-like cephalic hooks present. Cuticular ridges situated posteriorly to mouth. Amphids elliptical. Stoma lacking; oesophagus with corpus, isthmus and bulb. Nerve ring situated around isthmus. Excretory pore at isthmus level. Large paired deep transversely oriented fimbriate organs in caudal region with prominent lip-like basal rim. Females monodelphic, prodelphic, spermatheca set-off, distal tip of ovary near oesophageal base, vulva posterior with oblique vagina. Males monorchic; spicules paired and curved; thick gubernaculum with dorso-caudal apophysis and crurae, bursa absent.

TYPE AND ONLY SPECIES. *Yagansiella longicollis* sp. n.

ETYMOLOGY. Generic name refers to annelid host of the species.

### *Yagansiella longicollis* sp. n.

Figs 1-2

MEASUREMENTS. *Holotype female*. L = 1216  $\mu$ m; D = 153  $\mu$ m; Oes = 213  $\mu$ m; Ex = 129  $\mu$ m; NR = 105  $\mu$ m; Cd = 123  $\mu$ m; Ovum = 54 x 27  $\mu$ m; V% = 89.44%; a = 7.95; b = 5.71; c = 9.89.

*Paratype females* (n = 2). L = 1185-1458  $\mu$ m; D = 108-140  $\mu$ m; Oes = 215  $\mu$ m; Ex = 131-135  $\mu$ m; NR = 81-90  $\mu$ m; Ova = 52-54 x 25-27  $\mu$ m; Cd = 112-127  $\mu$ m; V% = 90.55-90.81; a = 10.41-10.97; b = 5.51-6.78; c = 10.58-11.48.

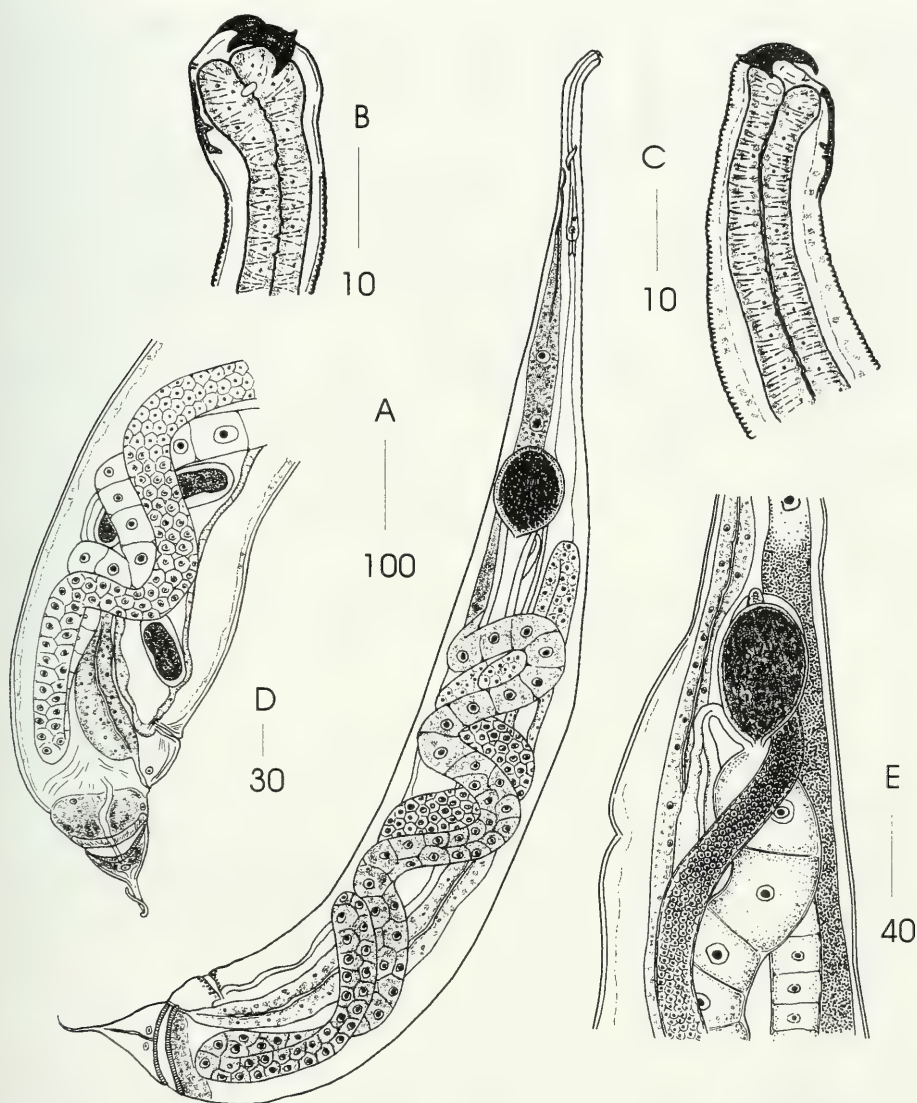


FIG. 1

*Yagansiella longicollis* gen. n., sp. n. Female. A – paratype, entire body; B – paratype, head end; C – holotype, anterior end; D – holotype, posterior end; E – holotype, spermatheca region. All in lateral position. Scale bars in  $\mu\text{m}$ .

*Paratype males* ( $n = 3$ ).  $L = 1093.67 \pm 142.1$  (930–1185)  $\mu\text{m}$ ;  $D = 83 \pm 25.2$  (60–110)  $\mu\text{m}$ ;  $Oes = 188.33 \pm 9.5$  (179–198)  $\mu\text{m}$ ;  $Ex = 118.33 \pm 6.7$  (114–126)  $\mu\text{m}$ ;  $NR = 99.33 \pm 7.8$  (93–108)  $\mu\text{m}$ ;  $Cd = 200.67 \pm 8.1$  (195–210)  $\mu\text{m}$ ;  $Sp$  (arc) =  $104.33 \pm 5.5$  (99–110)  $\mu\text{m}$ ;  $Sp$  (chord) =  $67 \pm 5.6$  (62–73)  $\mu\text{m}$ ;  $Gub = 30.33 \pm 2.1$  (28–32)  $\mu\text{m}$ ;  $a = 14.32 \pm 5.7$  (8.45–19.75);  $b = 5.8 \pm 0.6$  (5.2–6.3);  $c = 5.47 \pm 0.9$  (4.43–6.02).

**DESCRIPTION.** *Adults.* Very long and thin neck region and swollen body. Body starts to widen gradually behind the base of esophagus and turns uniformly wide from the point of where genital tube forms flexure. Terminal portion of tail filamentous. Epidermis thick. Spacious pseudocoel. Cuticle 1 thick, annulated at both ends, with annules  $1.5\ \mu\text{m}$  thick. Head bluntly rounded. No cephalic sensilla present. Head with paired, independently-moveable, submedian, claw-like cephalic hooks situated on anterior surface of head; base of each hook consists from pair of thick equal pointed diverged processes  $2\text{--}3\ \mu\text{m}$  long; longer pointed blade directed dorsad. Minute oral aperture shifted slightly dorsad near distal tips of blades. Stoma absent. Cuticular ridges on dorsal side just beneath mouth. Amphid faint, situated close to hooks base; its aperture transversely elongated. Anteriormost portion of esophagus slightly expanded. Slightest constriction of corpus at  $10\text{--}12\ \mu\text{m}$  from head end. Oesophagus slender, muscular, from very long corpus  $6\text{--}8\ \mu\text{m}$  wide, thinner long isthmus and bulb with granular secretion of dorsal oesophageal gland. Bulb elongated with nearly rectangular base,  $30\text{--}40\ \mu\text{m}$  long and  $10\text{--}11\ \mu\text{m}$  wide. One large nucleus of dorsal gland at posterior of bulb and two smaller ones of subventral glands situated more anteriorly. Nerve ring wide, encircling anterior part of isthmus. Excretory pore in  $20\text{--}40\ \mu\text{m}$  behind nerve ring,  $2\ \mu\text{m}$  wide. Excretory duct strongly cuticularized,  $2\ \mu\text{m}$  wide and  $105\text{--}153\ \mu\text{m}$  long. Excretory cell large, with granular content, observed untill mid-body. Cardia from two elongated cells. Intestine thick-walled, contains debris. Large paired symmetrically placed deep transversely oriented fimbriate organs in caudal region with prominent lip-like basal rim.

*Females.* Blades of head hooks  $7.67\pm 0.6$  ( $7\text{--}8$ )  $\mu\text{m}$  long, hook base  $5.33\pm 1.2$  ( $4\text{--}6$ )  $\mu\text{m}$  wide. Amphidial aperture  $3 \times 2\ \mu\text{m}$ . Oesophagus  $9.33\pm 0.6$  ( $9\text{--}10$ )  $\mu\text{m}$  wide at anterior, corpus  $8\ \mu\text{m}$  and isthmus  $6\ \mu\text{m}$  wide. Bulb  $37\pm 2.6$  ( $35\text{--}40$ )  $\mu\text{m}$  long and  $10.67\pm 0.6$  ( $10\text{--}11$ )  $\mu\text{m}$  wide. Genital tube starts in  $150\text{--}207\ \mu\text{m}$  behind the oesophageal base, sometimes extending prior to spermatheca, which situated in  $388.33\pm 30.4$  ( $363\text{--}422$ )  $\mu\text{m}$  from anterior. Tube thick, runs posteriorly to fimbriate organs, then turns back by convoluted course and forms rounded or elongated off-set spermatheca  $74.67\pm 17.5$  ( $60\text{--}94$ )  $\times$   $50\pm 26.5$  ( $30\text{--}80$ )  $\mu\text{m}$  with thick walls filled with spherical or bean-like spermatozoa  $1.5\text{--}2\ \mu\text{m}$  in diameter. Descending and ascending branches of genital tube spirally twisted. Spermatheca joined with thick-walled oviduct by thin tube. Thin-walled muscular uterus obscured by twists of ovary. Muscular vagina  $36.33\pm 4$  ( $32\text{--}40$ )  $\mu\text{m}$  long. Vulva at posterior. No post-uterine sack present. Anus in  $43.33\pm 7.6$  ( $35\text{--}50$ )  $\mu\text{m}$  posteriorly to vulva. Up to 6 eggs with thin finely punctated shells. Fimbriate organs with deep chamber,  $39\pm 5.3$  ( $35\text{--}45$ )  $\mu\text{m}$  long and  $66\pm 5.3$  ( $60\text{--}70$ )  $\mu\text{m}$  wide with prominent lip-like muscular rim  $5\text{--}7\ \mu\text{m}$  thick. A channel inside tail end runs through fimbriate organs. Terminal portion of tail  $50.67\pm 4$  ( $47\text{--}55$ ) long and  $5.33\pm 0.6$  ( $5\text{--}6$ )  $\mu\text{m}$  wide.

*Males.* Resembles females in body shape but a little shorter and less prominently expanded behind neck region. Amphidial aperture  $4.67\pm 1.2$  ( $4\text{--}6$ )  $\times$   $2.33\pm 0.6$  ( $2\text{--}3$ )  $\mu\text{m}$ . Testis reflexes at  $333.67\pm 94.2$  ( $255\text{--}430$ )  $\mu\text{m}$  from oesophageal base, flexure curved,  $180.67\pm 19.9$  ( $159\text{--}198$ )  $\mu\text{m}$  long. Developing spermatocytes in  $7\text{--}8$  rows, small, spherical ( $2\ \mu\text{m}$  in diameter). Testis very wide, ejaculatory duct muscular, separated from *vas deferens* by constriction. Spermia in *vas deferens* spherical or bean-like,



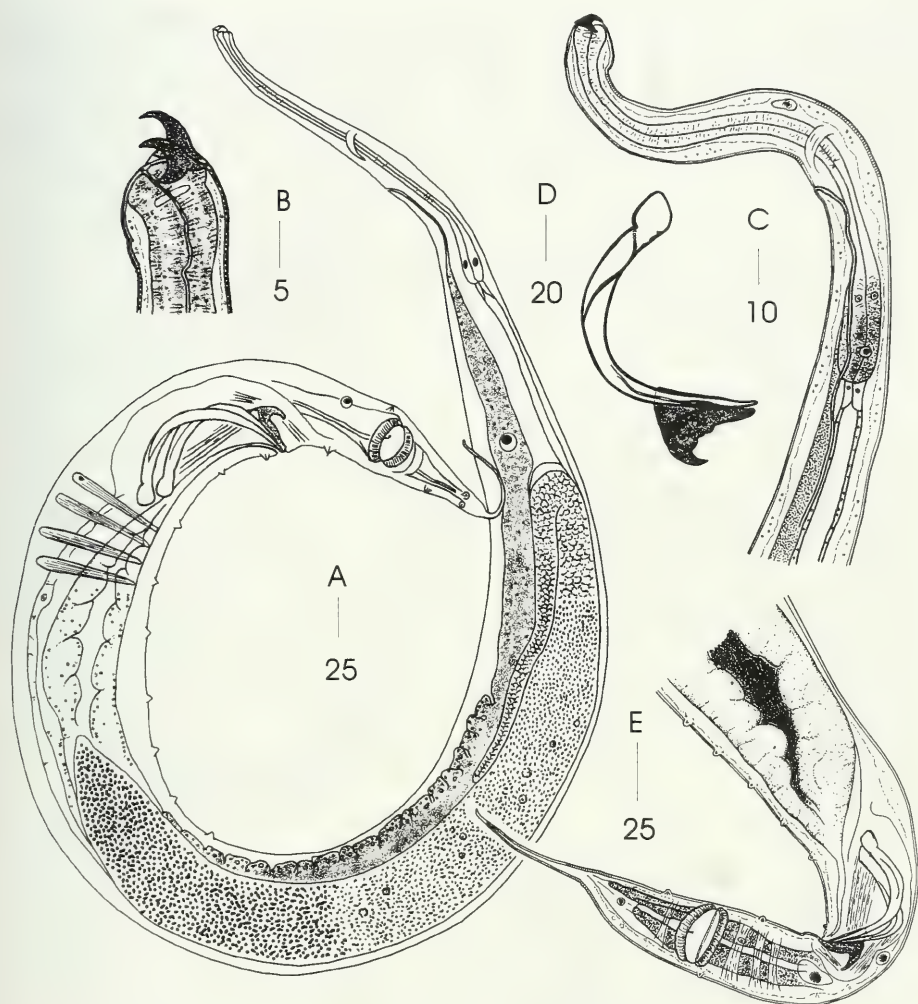


FIG. 2

*Yagansiella longicollis* gen. n., sp. n. Male. A – paratype, entire body; B – paratype, head end; C – paratype, anterior end; D – paratype, spicules and gubernaculum; E – paratype, tail. All in lateral position. Scale bars in  $\mu\text{m}$ .

resemble those from female spermatheca. Very long strongly cuticularized sickle-shaped paired spicules, with elongated manubria  $12.33 \pm 1.2$  (11–13)  $\mu\text{m}$  long and  $10.33 \pm 1.5$  (9–12)  $\mu\text{m}$  wide. Spicule shafts  $5.66 \pm 0.6$  (5–6)  $\mu\text{m}$  wide at mid-length tapering gradually to rounded tips and bearing two front ridges. Gubernaculum massive, dark-brown in colour, with dorso-caudal apophysis  $12.33 \pm 3.1$  (9–15)  $\mu\text{m}$  long and crurae as long as gubernaculum body. A slit in gubernaculum body parallel to spicules. Nine pairs of subventral precloacal and four (five) pairs of postcloacal papilli-form sensilla. First pair of postcloacal sensilla subventral, situated between anus and

fimbriate organ; second one dorsal in front of fimbriate organ; third subventral between fimbriate organ and terminal portion of tail; fourth subdorsal close to the latter and fifth lateral symmetrically to the fourth in a paratype specimen. Copulatory muscles prominent but bursa lacking. Fimbriate organs smaller than in females:  $24.67 \pm 3.1$  (22–28)  $\mu\text{m}$  long and  $22.33 \pm 2.3$  (21–25)  $\mu\text{m}$  wide with basal rim 4–5  $\mu\text{m}$  thick. Thick channel ends blindly posterior to fimbriate organ. Filamentous portion of tail  $71 \pm 3.6$  (68–75)  $\mu\text{m}$  long and 4  $\mu\text{m}$  thick.

TYPE HOST AND LOCALITY. *Yagansia spatulifera* (Mich.) AF 4262, Chile, Villarica Vulcan, 1200 m, 14.02.01, coll. and identified by C. Czudi.

TYPE HABITAT. Coelomic cavity at mid-body region.

TYPE SPECIMENS. Holotype female MHNG 35445 INVE and paratype female and two paratype males MHNG 35446 INVE deposited in Natural History Museum (Geneva, Switzerland).

DIFFERENTIAL DIAGNOSIS. The present species is closely related to *Ungella* Cobb, 1928. From the latter genus, it can be distinguished by position of extremity of ovary which is anterior in *Yagansiella* and posterior in *Ungella* and vulva position which places in front of anus whereas it is typically post-median. It differs from *Ungella* as well by having swollen body posterior and large and broad fimbriate organs of different shape. From *Plesioungella* Yeates *et al.*, 1998, which it resembles by swollen posterior, it differs by having paired spicules. From *Onychonema* Baylis, 1943 it differs by presence of prominent fimbriate organs which lacked in the former. From *Acanthungella* (Ivanova & Hope, 2004) it differs in lack of somatic sensilla.

ETYMOLOGY. The species name derived from Latin words *longus* (long) and *collum* (neck) and reflects appearance of the nematodes.

### *Ungella chilleana* sp. n.

Figs 3–4

MEASUREMENTS. *Holotype male*. L = 1205  $\mu\text{m}$ ; D = 48  $\mu\text{m}$ ; Oes = 182  $\mu\text{m}$ ; Ex = 149  $\mu\text{m}$ ; NR = 105  $\mu\text{m}$ ; Cd = 183  $\mu\text{m}$ ; Sp (arc) = 70  $\mu\text{m}$ ; Sp (chord) = 51  $\mu\text{m}$ ; Gub = 13  $\mu\text{m}$ ; a = 25.1; b = 6.63; c = 6.58.

*Paratype female*. L = 1218  $\mu\text{m}$ ; D = 90  $\mu\text{m}$ ; Oes = 215  $\mu\text{m}$ ; Ex = 170  $\mu\text{m}$ ; NR = 130  $\mu\text{m}$ ; Cd = 163  $\mu\text{m}$ ; V% = 64.5; a = 13.53; b = 5.67; c = 7.42.

DESCRIPTION. *Adults*. Anterior of body thin. Terminal portion of tail filamentous. Cuticle 1  $\mu\text{m}$  thick, annulated. Epidermis well-developed. Head truncate, with paired, independently-moveable, submedian cephalic hooks situated on anterior surface of head. Each hook from thick bone head-like base and pointed outwardly-curved blade and directed dorsad. Mouth shifted slightly dorsad near distal tips of blades. Stoma absent. Amphid pocket-like, situated close to hooks base; amphidial aperture transversely elongated. Anteriormost portion of esophagus slightly expanded. No head sensilla visible. Oesophagus straight, slender, from long finely muscular corpus, no distinct isthmus and narrow bulb with 3 nuclei of oesophageal glands. Base of oesophagus not rounded. Nerve ring situated a little farther back from mid-oesophagus. Excretory pore opposite anterior of bulb, 1.5  $\mu\text{m}$  thick. Excretory duct 1.5–2  $\mu\text{m}$  wide 90–100  $\mu\text{m}$  long. Excretory cell with fine granular content visible till mid-body. Cardia prominent from two large oval cells. Intestine thin.

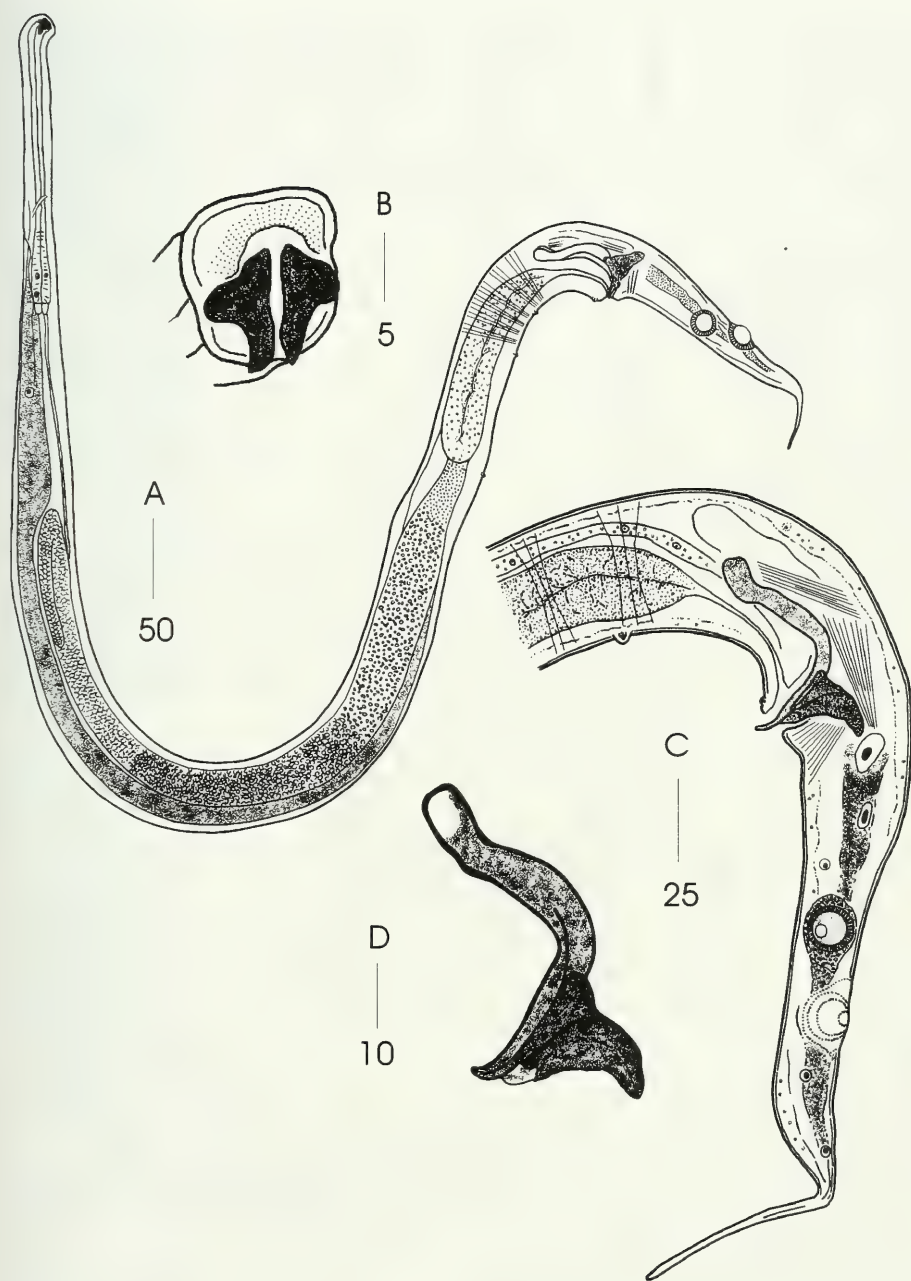


FIG. 3

*Ungella chileana* sp. n. Male holotype. A - entire body, lateral view; B - head end, apical view; C - tail, lateral view; D - spicules and gubernaculum, lateral view. Scale bars in  $\mu\text{m}$ .



*Male.* Body slender, tapering to both ends and slightly expanded in testis region. Cephalic hooks with blades 8  $\mu\text{m}$  long and base 5  $\mu\text{m}$  wide. Amphidial aperture 6 x 2  $\mu\text{m}$ . Oesophageal corpus 9  $\mu\text{m}$  wide at anterior, isthmus 8  $\mu\text{m}$  wide, bulb 13  $\mu\text{m}$  wide, 32  $\mu\text{m}$  long. Intestine collapsed. Testis reflexed in 298  $\mu\text{m}$  from anterior, flexure 95  $\mu\text{m}$  long. Developing spermatocytes numerous, in 4, then 8 rows, spherical, 1.5-2  $\mu\text{m}$  in diameter. *Vas deferens* separated from ejaculatory duct by constriction. Spermia spherical, 1-1.5  $\mu\text{m}$  in diameter. Spicular muscles and *levator ani* muscle prominent. Copulatory muscles present preanally. Bursa absent. Spicules paired, light brown in colour, cephalated, highly sclerotized, bent at one third length from distal part. Manubria elongated, 7  $\mu\text{m}$  wide and 14  $\mu\text{m}$  long, shafts distally 6  $\mu\text{m}$  wide, then gradually tapering to tips which curved anteriorly and bluntly rounded, 2  $\mu\text{m}$  thick. Gubernaculum darker than spicules, massive, parallel to spicules, with crurae 13  $\mu\text{m}$  wide embracing spicules and thick dorso-caudal apophysis 16  $\mu\text{m}$  long. Four pairs of preanal papilliform ventral sensilla. Two (?) pairs of postanal lateral papilla around left-side fimbriate organ. Fimbriate organs asymmetrically disposed, large, circular, raised, with fibrous basal rim 2  $\mu\text{m}$  thick, internal chamber covered by transparent membrane 11  $\mu\text{m}$  and aperture 4  $\mu\text{m}$  in diameter. Filamentous portion of tail 46  $\mu\text{m}$  long and 3  $\mu\text{m}$  thick.

*Female.* Body stout, very slightly tapering posterior to vulva. Tail abruptly changes into bluntly rounded terminus 8  $\mu\text{m}$  thick 98  $\mu\text{m}$  long. Cephalic hooks with blades 10  $\mu\text{m}$  long and base 7  $\mu\text{m}$  wide. Minute oral aperture 1  $\mu\text{m}$  wide. Amphidial aperture oval, 4 x 2  $\mu\text{m}$ , pouch 4  $\mu\text{m}$  wide 5  $\mu\text{m}$  long. Corpus 10  $\mu\text{m}$  wide, isthmus 8  $\mu\text{m}$  wide and bulb 14  $\mu\text{m}$  wide 37  $\mu\text{m}$  long very slightly displaced dorsally. Cuticularized meandering channel 5  $\mu\text{m}$  thick observed subventrally in vulva region running through gland with numerous nuclei (excretory gland?). Distal tip of ovary in 110  $\mu\text{m}$  posterior to vulva. Ovary runs back nearly to end of expanded part of tail, then returns to the same distance, then runs back to start and turns to anterior where reflexes in 408  $\mu\text{m}$  from oesophageal base and forms spermatheca. Spermatheca 95  $\mu\text{m}$  long 35  $\mu\text{m}$  wide packed with spherical spermatozoa resembled those from male testis. Thick-walled uterus with two smooth-shelled eggs 60 x 25  $\mu\text{m}$ . Vagina straight, muscular, 38  $\mu\text{m}$  long, with slightly protruded lips. Vulva post-median. Anus in 15  $\mu\text{m}$  before right-side fimbriate organ. Fimbriate organs situated slightly asymmetrically near extremity of expanded part of tail (distance between centres of these 20  $\mu\text{m}$ ), circular, raised, with basal rim 7  $\mu\text{m}$  thick 34  $\mu\text{m}$  in diameter and aperture 23  $\mu\text{m}$  in diameter covered with transparent membrane. Channel 4  $\mu\text{m}$  thick runs through fimbriate organs.

TYPE HOST AND LOCALITY. *Yagansia spatulifera* (Mich.) AF 4262, Chile, Villarica Vulcan, 1200 m, 14.02.01, coll. and identified by C. Czudi.

TYPE HABITAT. Coelomic cavity at mid-body region.

TYPE SPECIMENS. Holotype male MHNG 35447 and paratype female MHNG 35448 deposited in Natural History Museum (Geneva, Switzerland).

DIFFERENTIAL DIAGNOSIS. The genus *Ungella* comprises 7 species: *U. secta* Cobb, 1928, *U. astrida* Spiridonov, 2001, *U. burmensis* Ivanova & Hope, 2000, *U. ituriensis* Spiridonov, 2001, *U. kivuensis* Spiridonov, 2001, *U. mexicana* Ivanova & Hope, 2000 and *U. sucofera* Timm, 1962.

*Ungella chilleana* sp. n. is characterised by having swollen posterior of females and filamentous portion of tail; not-embedded cephalic hooks with characteristic head

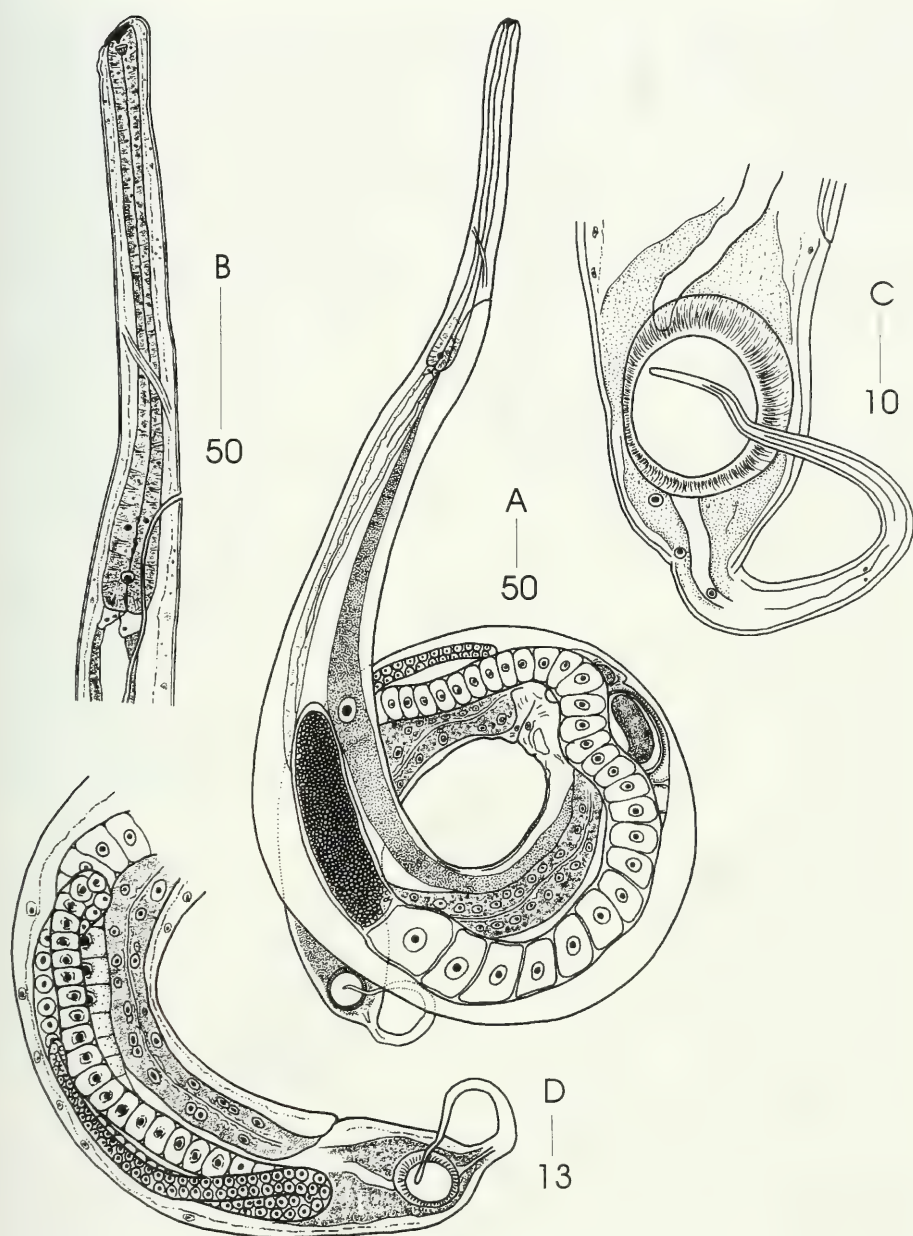


FIG. 4

*Ungella chilleana* sp. n. Female paratype. A - entire body; B - head end; C - fimbriate organ; D - tail. All in lateral position. Scale bars in  $\mu\text{m}$ .

bone-like base and pointed blades; pocket-like amphids; oesophagus from slender corpus, no isthmus and narrow basal bulb not rounded at base; nerve ring around mid-oesophagus; excretory pore opposite anterior of bulb; long excretory duct; large circular asymmetrically placed caudal fimbriate organs; paired highly sclerotised arcuate cephalated spicules and massive gubernaculum; 4 pairs of precloacal and 2 pairs post-cloacal male genital sensilla; extremity of ovary between vulva and anus; several loops of ovary; postmedian vulva; and by absence of cephalic sensilla.

The present species differs from the rest of *Ungella* by largest spicules of different shape and circular fimbriate organs, shorter female tail, more posterior vulva position, ovary arrangement and female body shape which is swollen not slender in posterior.

The present species resembles *U. kivuensis*, *U. astrida* and *U. ituriensis* in location of excretory pore opposite basal bulb and *U. ituriensis* as well in location of ovary tip cell but differs by having differently shaped surfactantly attached *vs* embedded cephalic hooks, differently shaped much longer spicules, expanded *vs* slender posterior of females, filamentous terminal portion of tail *vs* gradually pointing tail, post-median *vs* median vulva position, shorter and thinner oesophagus and fimbriate organs of different shape and size. From *U. secta*, *U. burmensis*, *U. mexicana*, *U. sucofera*, *U. micronychium* n. sp. the present species differs in location of excretory pore which in former species is well behind the oesophageal base, by having differently shaped much longer spicules, expanded *vs* slender posterior of females. From *U. secta*, *U. burmensis*, *U. mexicana* the present species differs also by having asymmetrically placed larger fimbriate organs *vs* small elliptical ones. From *U. secta*, *U. burmensis*, *U. sucofera*, *U. kivuensis* and *U. astrida* the present species is distinguished by location of ovary tip cell between vulva and anus *vs* in tail and from *U. secta* by absence *vs* presence of bursa.

ETYMOLOGY. The species name refers to locality of annelid host.

### *Ungella micronychium* sp. n.

Fig. 5

MEASUREMENTS. *Holotype male*. L = 862  $\mu$ m; D = 34  $\mu$ m; Oes = 99  $\mu$ m; Ex = 124  $\mu$ m; NR = 69  $\mu$ m; Cd = 107  $\mu$ m; Sp (arc) = 51  $\mu$ m; Sp (chord) = 43  $\mu$ m; Gub = 17; a = 25.35; b = 8.71; c = 8.06.

*Paratype male*. L = 964  $\mu$ m; D = 35  $\mu$ m; Oes = 92  $\mu$ m; Ex = 124  $\mu$ m; NR = 62  $\mu$ m; Cd = 106  $\mu$ m; Sp (left, arc) = 47  $\mu$ m; Sp (right, arc) = 40  $\mu$ m; Sp (left, chord) = 29  $\mu$ m; Sp (right, chord) = 32  $\mu$ m; Gub = 17  $\mu$ m; a = 27.54; b = 10.48; c = 9.09.

DESCRIPTION. *Males*. Body slender, slightly tapering to anterior end, tail curved, conoid, spicate. Cuticle thin, smooth. Epidermis well-developed, up to 10  $\mu$ m thick. Head truncate, hooks triangle-shaped, 5  $\mu$ m long 2  $\mu$ m thick, slightly embedded. Mouth shifted dorsad, oral aperture minute, stoma absent. No head sensilla. Amphids with oval apertures 3.5 x 1.5  $\mu$ m and pouch 5 x 4  $\mu$ m. Oesophagus from corpus 43-48  $\mu$ m long and 6-7  $\mu$ m wide at mid-length, with basal widening as wide as bulb, isthmus 5  $\mu$ m wide 23-30  $\mu$ m long and bulb 9-12  $\mu$ m and 17-21  $\mu$ m long. Bulb piriform with granular secretion of dorsal oesophageal gland. Nerve ring encircles anterior of isthmus. Excretory pore in 25 posterior to oesophageal bulb, 1  $\mu$ m wide, disposed on hillock 1.5  $\mu$ m high. Excretory duct thin, 20-22  $\mu$ m long, leads to excretory cell



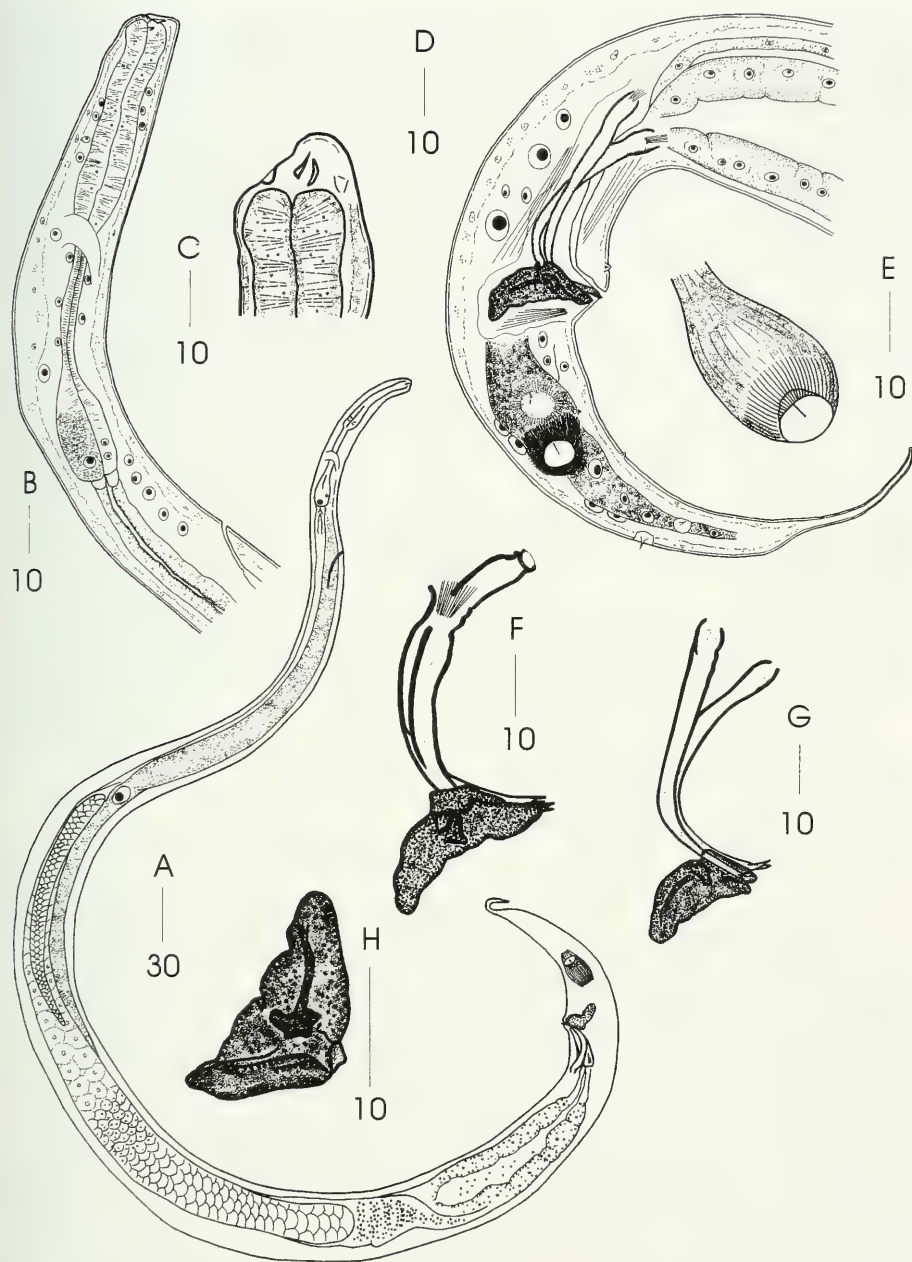


FIG. 5

*Ungella micronychium* sp. n. Male. A – paratype, entire body, lateral view; B – holotype, anterior end, lateral view; C – paratype, head end, subdorsal view; D – holotype, tail, lateral view; E – fimbriate organ, lateral view; F – paratype, spicules and gubernaculum, lateral view; G – holotype, spicules and gubernaculum, lateral view; H – holotype, gubernaculum, lateral view. Scale bars in  $\mu\text{m}$ .

extending till mid-body. Three large nuclei observable at anterior region of cell: one near testis flexure and two smaller near distal part of duct. Content of excretory cell in anterior region from well-defined granules and homogenous in posterior one. Testis reflexed at 260-320  $\mu\text{m}$  from oesophageal base. Flexure thin and 120-135  $\mu\text{m}$  long. Developing spermatocytes in 2, then 3 rows, 3-4 x 4  $\mu\text{m}$ , then 6-7 x 7  $\mu\text{m}$  in size. Spermatids amoeboid, 5-7 x 6-8  $\mu\text{m}$ . *Vas deferens* posteriorly set off from ejaculatory duct. Ejaculatory duct from large cells. Spermia numerous, spherical 1  $\mu\text{m}$  in diameter. Spicules light brown in colour, strongly cuticularized, curved, not distinctively cephalate. Holotype male spicules equal, thin, with nearly straight proximal and curved distal parts, bent at one third of its length from tips on nearly right angle. Manubria elongated, a little wider than shafts, which are 5  $\mu\text{m}$  wide. Distal spicule tips pointed, curved upward and separated by cleft 5-6  $\mu\text{m}$  deep. Paratype spicules unequal; left spicule the same shape as holotype but manubrium more prominent and the right one shorter with wider shaft and no distinct manubrium. Dark massive gubernaculum with small crurae, lateral ridge and short lateral apophysis. Tail curved, terminal portion 24-28  $\mu\text{m}$  long and 2  $\mu\text{m}$  wide. Fimbriate organs prominent, asymmetrically placed, right one in 20-25  $\mu\text{m}$  posterior to anus, left in 10-12  $\mu\text{m}$  farther back. Fimbriate organs with bowl-shaped chamber 30  $\mu\text{m}$  long and 20  $\mu\text{m}$  wide and circular aperture 6-7  $\mu\text{m}$  in diameter partially covered with transparent membrane surrounded by raised fibrous basal rim 7-8  $\mu\text{m}$  thick. Single sensillum protruded from fimbriate organ aperture. A pair of subventral preanal papilliform sensilla, two pairs of subventral post-cloacal sensilla around posterior fimbriate organ and two pairs of lateral and subdorsal sensilla situated close to the end of conical portion of tail.

*Females.* Not found.

TYPE HOST AND LOCALITY. *Yagansia diversicolor* Beddard, 965.171, Chile, Prov. Valdivia, 25.10.65, coll. and identified by A. Zicsi.

TYPE HABITAT. Coelomic cavity at anterior.

TYPE SPECIMENS. Holotype male MHNG 35449 INVE deposited in Natural History Museum (Geneva, Switzerland).

DIFFERENTIAL DIAGNOSIS. *Ungella micronychium* sp.n. is characterised by having truncate head bearing minute cephalic hooks, small pocket-like amphids, short oesophagus from corpus, isthmus and bulb, nerve ring on isthmus, excretory pore posterior to oesophageal bulb, arcuate not distinctively cephalate spicules with bifurcate distal tips, dark massive gubernaculum, prominent asymmetrically placed caudal fimbriate organs with bowl-shaped chambers, two pairs precloacal and four pairs post-cloacal genital sensilla.

Present species is closest to *U. mexicana* Ivanova & Hope, 2000 by size of cephalic hooks, shape of oesophagus, tail, spicules, gubernaculum and excretory pore position. It can be distinguished from the former species by longer spicules, oesophagus and tail, less prominent amphids, absence of cephalic sensilla and much larger asymmetrically placed fimbriate organs. It differs from the rest of *Ungella* by having minute cephalic hooks, different shape of fimbriate organs in tail and spicules and gubernaculum.

ETYMOLOGY. The species name derived from Greek words «mikros» (small) and «onychium» (claw or talon) and reflects the size of cephalic hooks. It is a noun in apposition.

*Patagoniella* gen. n.

DIAGNOSIS. Rhabditida, Drilonematoidea, Ungellidae. Blade-like cephalic hooks with amalgamated base present. Amphids with thickened rim and no pouch. Stoma short; displaced dorsally, esophagus nearly cylindrical. Nerve ring situated around anterior of bulb. Excretory pore situated closely to head end. Paired fimbriate organs in caudal region asymmetrically placed, with large subcuticular chamber, small external aperture and thick, basal rim. Males monorchic; spicules paired and curved; small boat-like gubernaculum with dorso-caudal apophysis. Bursa present. Female prodelphic, monodelphic, spermatheca set off; vulva at anterior third of body length with oblique vagina. No uterine sack present.

TYPE AND ONLY SPECIES. *Patagoniella capitoporus* sp. n.

ETYMOLOGY. Generic name refers to geographic region where the annelid host was found.

*Patagoniella capitoporus* sp. n.

Figs 6-7

MEASUREMENTS. *Holotype female*. L = 1494  $\mu$ m; D (max) = 40  $\mu$ m; D (behind V) = 26  $\mu$ m; NR = 95  $\mu$ m; Oes = 122  $\mu$ m; Ex = 6  $\mu$ m; Cd = 325  $\mu$ m; V% = 36.81; Ovum = 60 x 26  $\mu$ m, a = 37.35; b = 12.25; c = 4.6.

*Paratype females* (n = 4). L = 1592 $\pm$ 170.9 (1451-1831)  $\mu$ m D (max) = 42.5 $\pm$ 2.9 (40-45)  $\mu$ m; D (behind V) = 25 $\pm$ 3.6 (22-30)  $\mu$ m; NR = 89.25 $\pm$ 8.7 (79-100)  $\mu$ m; Oes = 117.8 $\pm$ 7.9 (107-126)  $\mu$ m; Ex = 6.5 $\pm$ 1 (5-7)  $\mu$ m; Cd = 325 $\pm$ 26.3 (302-360)  $\mu$ m; V% = 35.1 (34.29-36.27); Ova = 53.25 $\pm$ 5.4 (49-61)  $\mu$ m x 22.5 $\pm$ 3.3 (18-25)  $\mu$ m; a = 37.69 $\pm$ 5.8 (32.24-45.78); b = 13.56 $\pm$ 1.5 (11.52-15.26); c = 4.91 $\pm$ 0.5 (4.44-5.55).

*Paratype males* (n = 7). L = 1424.43 $\pm$ 214.1 (1234-1813)  $\mu$ m; D = 29 $\pm$ 3.6 (22-34)  $\mu$ m; NR = 86.57 $\pm$ 6.5 (75-95)  $\mu$ m; Oes = 112 $\pm$ 6.1 (102-119)  $\mu$ m; Ex = 5.57 $\pm$ 0.8 (5-7)  $\mu$ m; Cd = 158.14 $\pm$ 10.4 (144-172)  $\mu$ m; Sp (arc) = 33.57 $\pm$ 4.7 (29-42)  $\mu$ m; Sp (chord) = 27 $\pm$ 3.8 (22-34)  $\mu$ m; Gub = 8.86 $\pm$ 2 (6-12)  $\mu$ m; a = 49.98 $\pm$ 10.6 (64.75-36.29); b = 10.94 $\pm$ 4.6 (1.5-16.94); c = 9.03 $\pm$ 1.4 (7.69-11.55).

*Juveniles* (n = 3). L = 550 $\pm$ 94.3 (479-657)  $\mu$ m; D = 19 $\pm$ 5.3 (15-25)  $\mu$ m; NR = 63.33 $\pm$ 2.9 (60-65)  $\mu$ m; Oes = 104.3 $\pm$ 5.5 (98-108)  $\mu$ m; Ex = 4  $\mu$ m; Cd = 98 $\pm$ 43.7 (57-144)  $\mu$ m; a = 29.57 $\pm$ 4.2 (26.28-34.3); b = 5.31 $\pm$ 1.2 (4.44-6.7); c = 6.16 $\pm$ 2.0 (4.56-8.4)

DESCRIPTION. *Adults*. Body cylindrical, long, slender, tapering to tail. Head bluntly rounded or truncate, inclined dorsally. Cuticle 1-2  $\mu$ m thick, annulations 1-1.5  $\mu$ m visible in tail. Epidermal layer from 1  $\mu$ m in anterior end to 5  $\mu$ m in tail. Cephalic hooks slightly embedded into head tissue. Base of hooks amalgamated with processes inclined. Dorsal hook blades diverged, longer than base. No head sensilla visible. Mouth and stoma slightly displaced dorsally. Amphidial apertures elliptical, with thin cuticularized rim, situated just behind hooks base and slightly displaced dorsally. Amphidial pouch not observed. Excretory pore in 5.57-6.4  $\mu$ m from anterior, flattened in dorso-ventral direction. Excretory duct 1.14-1.2  $\mu$ m wide, proceeds up to 35.8-41.43  $\mu$ m, then narrowing to less than 1  $\mu$ m wide and runs until after oesophagus. Excretory cell large, with granular content and huge nucleus. Oesophagus muscular, slender, nearly cylindrical, with slightest expansion at posterior bulb. Isthmus less than 1  $\mu$ m thinner than corpus and about 1.5-2  $\mu$ m than bulb. Three nuclei of oesophageal



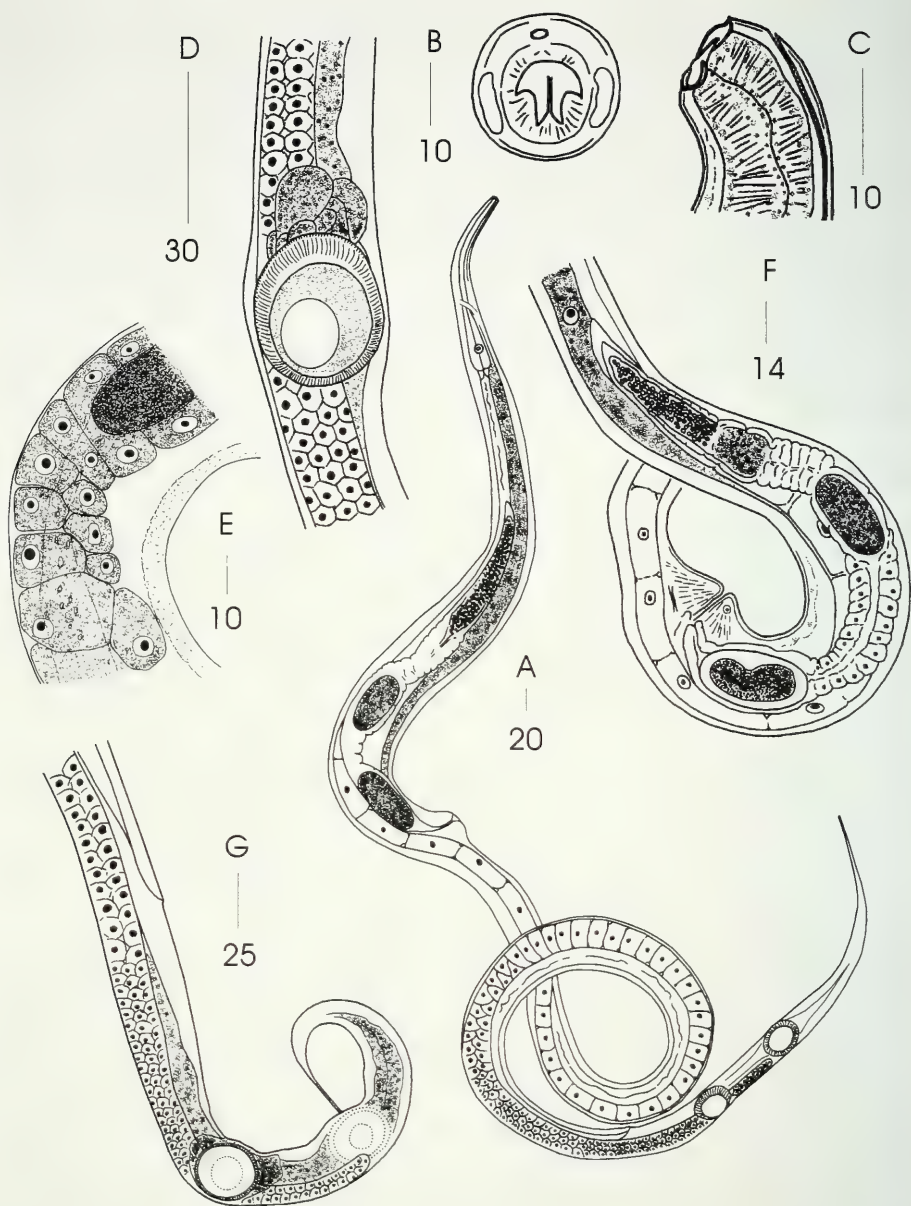


FIG. 6

*Patagoniella capitoporus* gen. n., sp. n. Female. A – holotype, entire body, lateral view; B – paratype, head end, apical view; C – paratype, head end, lateral view; D – paratype, fimbriate organ, lateral view; E – paratype, part of oviduct, lateral view; F – paratype, spermatheca, oviduct and uterus, lateral view; G – paratype, tail, lateral view. Scale bars in  $\mu\text{m}$ .

glands in posterior of bulb. Nerve ring wide, encircling anterior of bulb. Cardia large. Intestine collapsed, with walls composed from large cells and cuticularized lining. Pair of asymmetrical fimbriate organs in tail.

*Females.* Body tapered dramatically just behind vulva. Lateral chord 6-9 ( $7.4 \pm 1.1$ )  $\mu\text{m}$  wide at mid-body. Hook blades 4-6 ( $5.4 \pm 0.9$ )  $\mu\text{m}$  long, hook base 3-4 ( $3.6 \pm 0.5$ )  $\mu\text{m}$  long. Stoma 5-6 ( $5.4 \pm 0.5$ )  $\mu\text{m}$  long and 1-2 ( $1.8 \pm 0.4$ )  $\mu\text{m}$  wide. Amphids 5-4 ( $4.4 \pm 0.5$ )  $\times$  2 ( $2 \pm 0$ )  $\mu\text{m}$ , situated close to hook base. Excretory pore in 5-7 ( $6.4 \pm 0.9$ )  $\mu\text{m}$  from head end. Nerve ring about 10  $\mu\text{m}$  thick. Anterior of corpus 8-10 ( $9.2 \pm 0.8$ )  $\mu\text{m}$  wide, corpus 8-9 ( $8.6 \pm 0.5$ )  $\mu\text{m}$  wide, isthmus 6-8 ( $7 \pm 1$ )  $\mu\text{m}$  wide, bulb 27-35 ( $29.6 \pm 3.2$ )  $\mu\text{m}$  long and 10-11 ( $10.4 \pm 0.5$ )  $\mu\text{m}$  wide. Genital tube starts in tail, runs on dorsal side and reflexed in 174-272 ( $229 \pm 40.4$ )  $\mu\text{m}$  from anterior, where forms long narrow set-off spermatheca 63-134 ( $91.4 \pm 26.2$ )  $\mu\text{m}$  long and 12-17 ( $14.6 \pm 1.9$ )  $\mu\text{m}$  wide filled with oval or spherical spermatozoa 1.5-4  $\times$  2-4  $\mu\text{m}$  in size. Oviduct from large cells, about 80-152  $\mu\text{m}$  long. Single mature smooth-shelled egg 49-61 ( $54.6 \pm 5.6$ )  $\times$  18-26 ( $23.2 \pm 3.3$ )  $\mu\text{m}$  in uterus. Spermatozoa in uterus as in spermatheca. Egg shell 1  $\mu\text{m}$  thick. Vulva at the level of one-third length of the body. Lips protruded. Vagina muscular, obliquely inclined, 15-18 ( $17 \pm 1.2$ )  $\mu\text{m}$  long. No post-uterine suck present. Tail long, conical, initially as wide as before anus, then gradually pointing and ends in conoid portion 23-34 ( $28.8 \pm 4.1$ )  $\mu\text{m}$  long and 2-3 ( $2.6 \pm 0.5$ )  $\mu\text{m}$  wide. Fimbriate organs wider than tail diameter, cause slight swelling of tail. First fimbriate organ situated in 80-95 ( $87.2 \pm 7$ )  $\mu\text{m}$  behind anus, the next one in 35-52 ( $43.8 \pm 7.1$ )  $\mu\text{m}$  farther back. Fimbriate organs slightly raised, longitudinally oval, with fibrous basal rim 29-36 ( $31 \pm 2.8$ )  $\times$  17-24 ( $19.6 \pm 2.7$ )  $\mu\text{m}$ , fringed internally with thin rim and deep chamber 17-24 ( $20.8 \pm 2.8$ )  $\times$  12-16 ( $14.2 \pm 1.6$ )  $\mu\text{m}$ , half-covered from surface by transparent membrane. In several specimens circular membrane aperture 13-14  $\mu\text{m}$  in diameter observed. Bottom of organ chamber covered by fibers. Posterior fimbriate organ slightly smaller in several specimens.

*Males.* Body length, anterior end, oesophagus and excretory system as in females with cephalic hooks little smaller in size than in females (blades  $4.71 \pm 0.5$  (3-40)  $\mu\text{m}$ ; base  $3.43 \pm 0.8$  (2-4)  $\mu\text{m}$ ). Amphids 4-7 ( $4.86 \pm 1.1$ )  $\times$  1-2 ( $1.71 \pm 0.8$ )  $\mu\text{m}$ . Lateral chord  $4.71 \pm 0.5$  (4-5)  $\mu\text{m}$ . Cuticularized spot 1  $\mu\text{m}$  in size situated opposite excretory pore on dorsal side observed in several specimens. Testis reflexed at 271.71  $\pm$  31.2 (220-310)  $\mu\text{m}$  from anterior, testis flexure 177.57  $\pm$  46.2 (124-250)  $\mu\text{m}$  long. Developing spermatocytes hexagonal, arranged in 2, then 3 rows, 4  $\times$  4, then 7  $\times$  7; immature sperm in testis with irregular outlines arranged in no rows, 4-7 in diameter, spermatids in *vas deferens* spherical, numerous, about 1-1.5 in diameter. Constriction between *vas deferens* and ejaculatory duct, spermatids in ejaculatory duct 2.5-3.5 in diameter. Tail conical with short filamentous terminal portion 15-22 ( $18.29 \pm 2.6$ )  $\mu\text{m}$  long. Spicules not distinctively cephalate, sickle-shaped, with manubria  $2.86 \pm 0.4$  (2-3)  $\times$   $2.71 \pm 0.5$  (2-3)  $\mu\text{m}$  blades  $2.14 \pm 0.4$  (2-3)  $\mu\text{m}$  wide at mid-length and pointed distal tips. Gubernaculum minute, boat-shaped, with proximal hook  $3.14 \pm 2.6$  (15-22)  $\mu\text{m}$  long bent posteriad. Long thin ribbed bursa present. Four-five pairs of postanal sub-ventral sensilla. First one in 12-25 posteriorly to anus, next one in 11-13 farther back and situated more laterally, third in front of anterior fimbriate organ, fourth between fimbriate organs, last one just behind posterior fimbriate organ. Each sensillum with

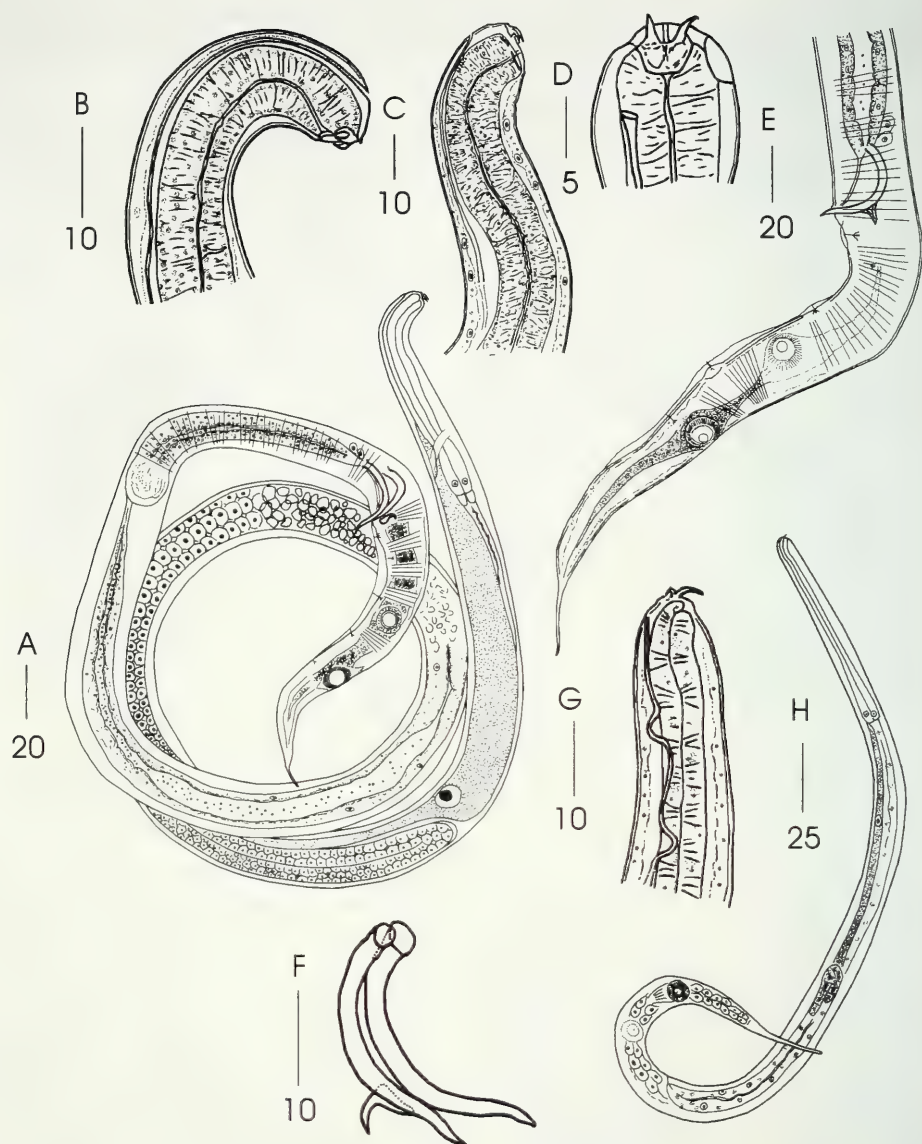


FIG. 7

*Patagoniella capitoporus* gen. n., sp. n. Male and juvenile. A – paratype male, entire body, lateral view; B, C – anterior end, paratype male, lateral view; D – head, paratype male, ventral view; E – male tail, lateral view; F – spicules and gubernaculum, lateral view; G – juvenile anterior end, lateral view; H – entire juvenile, lateral view. Scale bars in  $\mu\text{m}$ .

prominent base 1.5 high and fine bristle 4-10 high. Fimbriate organs the same in structure as in females but smaller in size, first one situated in  $46.43 \pm 7.2$  (36-60)  $\mu\text{m}$  posterior to anus and second one in  $18 \pm 7.9$  (7-31)  $\mu\text{m}$  farther back. First fimbriate



organ with basal rim  $17\pm 2.8$  (15-23)  $\times$   $12.71\pm 2.5$  (10-17)  $\mu\text{m}$ , nearly spherical internal chamber  $8.57\pm 1.1$  (8-11)  $\times$   $8.14\pm 1.5$  (6-11)  $\mu\text{m}$ ; second one with rim  $14\pm 2.2$  (11-18)  $\times$   $11.20\pm 1.4$  (10-14)  $\mu\text{m}$  and chamber  $7.86\pm 0.4$  (7-8)  $\times$   $7.43\pm 1.1$  (5-8)  $\mu\text{m}$ . Circular aperture in membrane covered the organ 3-5  $\mu\text{m}$  in diameter.

*Juveniles.* Slender body, anterior end rounded, tail conical with filamentous terminal portion  $15\pm 6.6$  (9-22)  $\mu\text{m}$  long. Cephalic hooks thin with blades  $3.33\pm 0.6$  (3-4)  $\mu\text{m}$  and base  $1.33\pm 0.6$  (1-2)  $\mu\text{m}$  long. Amphids not observable. Excretory pore and duct 1  $\mu\text{m}$  or less wide, duct visible until after oesophagus base. Oesophagus with corpus 5  $\mu\text{m}$  and isthmus 4  $\mu\text{m}$  and basal bulb  $8\pm 1$  (7-9)  $\mu\text{m}$  wide. Cardia and intestine well-developed. Genital primordium in  $231\pm 18.2$  (210-242)  $\mu\text{m}$  from anterior, reflexed,  $98.3\pm 53.9$  (60-160)  $\mu\text{m}$  long. Fimbriate organs circular, first situated in  $14.67\pm 6.7$  (9-22)  $\mu\text{m}$  from anus and second one in  $13.33\pm 5$  (8-18)  $\mu\text{m}$ . Both fimbriate organs with basal rim  $8.67\pm 1.5$  (7-10)  $\mu\text{m}$  in diameter and chamber  $5\pm 1$  (4-6)  $\mu\text{m}$  in diameter. Aperture in covering membrane not observable.

TYPE HOST AND LOCALITY. *Yagansia papillosa* AF 653, Chile, prov. Bahia Pond, Patagonic forest, 6.10.89, collected and identified by Mr Covarubias.

TYPE HABITAT. Coelomic cavity.

TYPE SPECIMENS. Holotype female MHNG 35450 INVE, three paratype females and seven paratype males MHNG 35451 INVE and two juveniles MHNG 35452 INVE deposited in Natural History Museum (Geneva, Switzerland).

DIFFERENTIAL DIAGNOSIS. The species resembles most members of *Ungella* Cobb, 1928 in general morphology but differs from all of them in having of excretory pore closely to anterior end and more anterior position of vulva (at one third body length vs median or post-median position). From *Plesiungella* Yeates *et al.*, 1998, it differs by presence of paired spicules of different shape and slender posterior of females. From *Onychonema* Baylis, 1943, it can be distinguished by presence of fimbriate organs. From *Acanthungella* (Ivanova & Hope, 2004), it differs by absence of somatic sensillae along the body.

ETYMOLOGY. Species name derived from Latin words *caput* (head) and *porus* (pore) and reflects the anteriormost position of excretory pore. It is a noun in apposition.

#### KEY TO GENERA OF UNGELLIDAE WITH SPICULAR APPARATUS

- 1 Somatic sensilla present ..... *Acanthungella* Ivanova & Hope, 2004
- Somatic sensilla absent ..... 2
- 2 Single spicule ..... *Plesiungella* Yeates, Spiridonov & Blakemore, 1998
- Paired spicules ..... 3
- 3 Caudal fimbriate organs («suckers») absent ..... *Onychonema* Baylis, 1943
- Caudal fimbriate organs present ..... 4
- 4 Excretory pore near head end ..... *Patagoniella* gen. n.
- Excretory pore at the level of mid-oesophagus or well behind the oesophageal base ..... 5
- 5 Extremity of ovary behind vulva which is median or post-equatorial  
..... *Ungella* Cobb, 1928
- Extremity of ovary behind oesophageal base, vulva in front of anus  
..... *Yagansiella* gen. n.

## TAXONOMICAL REMARKS

Drilonematid fauna of Neotropic acanthodrilids is the less (if at all) studied amongst all Drilonematoidea. Till now only *Ungella mexicana* was described from *Howascolex* sp. from Mexico. Two new *Ungella* species and two new genera were described above. Both *Ungella* species demonstrate similarity in shape of oesophagus, spicules and gubernaculum and presence of prominent fimbriate organs. From type species *U. secta* Cobb, 1928 they differ by structure of cephalic hooks attached to head surface whereas in *U. secta* they have deeply embedded shafts. Excretory pore position seems to be variable in the genus and takes place or opposite nerve ring (*U. kivuensis* Spiridonov, 2001, *U. astrida* Spiridonov, 2001, *U. ituriensis* Spiridonov, 2001, *U. chilleana* sp. n.) either behind oesophageal bulb (*U. secta*, *U. burmensis* Ivanova et Hope, 2000, *U. mexicana*, *U. sucofera* Timm, 1962, *U. micronychium* sp. n.) whereas nerve ring position on isthmus is constant. Oesophagus shape, presence of few (or more often single) thin-shelled eggs and median/post-median vulva position and structure of excretory system is as well constant. Typically, ovary is leading straight to anterior end though in *U. chilleana* it makes some loops at posterior. Short post-uterine sack present (*U. kivuensis*, *U. astrida*, *U. ituriensis*, *U. sucofera*) or absent. For male reproductive system, morphologically distinct *vas deferens* and ejaculatory duct, spherical small-sized immature sperm, curved paired spicules, sometimes bifurcated (*U. mexicana*, *U. micronychium*) are characteristic. Bursa present (*U. secta*) or absent (the rest of species). Fimbriate organs vary greatly in shape, size and position.

*Yagansiella longicollis* gen. n., sp. n. possess some unusual features. Cuticular ridges on its anterior end reminds of cephalic armature of Homungellidae though these not joined with hooks which is single in the latter. Anterior placement of female gonoduct extremity in *Yagansiella* is unusual among drilonematids, as well as anteriormost position of excretory pore in *Patagoniella*. Appearance of *Yagansiella longicollis* resembles in some way of oxyurids inhabiting earthworm gut – for instance, *Posteroovulva danieli* Spiridonov, Ivanova, 1998 – in body shape, prominent annulation, spacious pseudocoel, muscular vagina though the present species undoubtedly belongs to Ungellidae.

## ACKNOWLEDGEMENTS

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## New species of Leiodidae (Coleoptera) and new records from the Neotropical Region

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**New species of Leiodidae (Coleoptera) and new records from the Neotropical region.** - Four new species of Neotropical Leiodidae are described: *Adelopsis catarina* sp. n., *Adelopsis curvipes* sp. n., *Eucatops (Eucatops) troglodytes* sp. n. and *Parapaulipalpina giachinoi* sp. n. New information is given on certain basic diagnostic characters of several species, as well as further records on their distribution in the Neotropical Region.

**Keywords:** Coleoptera - Leiodidae - Cholevinae - Camiarinae - taxonomy - *Adelopsis catarina* sp. n. - *Adelopsis curvipes* sp. n. - *Eucatops (Eucatops) troglodytes* sp. n. - *Parapaulipalpina giachinoi* sp. n.

## INTRODUCTION

This paper on the family Leiodidae, subfamilies Cholevinae and Camiarinae, is the continuation of research started by the author in 1991 for the fauna of Neotropical Region. The 11 publications which are of listed in the bibliography.

Four new species belonging to the genera *Adelopsis*, *Eucatops* and *Parapaulipalpina* are described in this study. New data on the distribution of other species are given, as well as descriptions and illustrations of structures considered essential for differentiating the species but which had not been indicated in original descriptions or later papers, such as the male genital segment and spermathecal complex.

## MATERIAL AND METHODS

A total of 477 specimens of the collection of the Muséum d'histoire naturelle, Geneva (Switzerland), from now on referred to as MHNG and of the private collection of Dr P. M. Giachino, Turin (Italy), from now on referred to as CPMG were studied.

The types of *Adelopsis insolitus* Szymczakowski, 1961 and *Adelopsis triangulifer* Szymczakowski, 1961 deposited in the Swedish Museum of the Natural History, Stockholm (Sweden) were also examined.

As all the studied material was dry, for the examination of many of the structures the specimens had to be softened in boiling water for 10-15 minutes. Some of the examined pieces were placed in hot 10% KOH to separate adherences. All the extracted structures were mounted on a small rectangular piece of plastic in a drop of "Hoyer liquid". Illustrations were by camera lucida.

## SYSTEMATICS

**CHOLEVINAE KIRBY, 1837**

PTOMAPHAGINI JEANNEL, 1911

***Adelopsis catarina* sp. n.**

*Type material.* Holotype, ♂. Nova Teutônia, Santa Catarina State (Brazil), IV.1976, Fr. Plaumann leg. (MHNG). Paratypes: Nova Teutônia, Santa Catarina State (Brazil). 2 ♀♀, III-1976; 2 ♀♀, I-1977; 2 ♂♂, VI-1977; 1 ♂, IX-1978, Fr. Plaumann leg. (MHNG); 1 ♂ (CPMG) and 1 ♂ (CJSC), Zoology Department, University of León.

*Diagnosis.* Length, 2.40-2.80 mm. Segments of antennal club of almost equal thickness; protarsi male dilated; genital segment with median region of spiculum gastrale wide and lobulate; aedeagus with right lobe arcuate and pointed in apical region, bearing numerous microsetae on right dorsal face of median lobe; spermathecal complex with numerous spirals forming arches in posterior region.

*Description.* MALE. Holotype: length, 2.80 mm; width, 1.30 mm. (Paratypes: length, 2.40-2.80 mm; width, 1.20-1.34 mm). Overall shape oval, fairly robust (Plate 1: Fig. 1). Metathoracic wings fully developed. Reddish brown colour, with legs and base of antennae lighter. Pubescence very short, fine, golden and laid back. Transverse striolae weakly visible on head and clearly visible on pronotum and elytra.

Head 1.60 times narrower than pronotum; eyes developed. Antennae short, 3.20 times shorter than body, not surpassing basal region of pronotum; last five segments almost of equal width; 2<sup>nd</sup> to 6<sup>th</sup> segments decreasing progressively in length; 6<sup>th</sup> segment transverse, the longest being the 1<sup>st</sup> (Fig. 2). Using the length of the 9<sup>th</sup> segment as a basis, relative length of each segment from 1<sup>st</sup> to 11<sup>th</sup>: 1.80-1.30-1.08-0.85-0.77-0.72-1.05-0.57-1.00-1.00-1.25. Proportions between the length and width of each club segment, from the 7<sup>th</sup> to the 11<sup>th</sup>: 1.28-0.69-0.96-0.96-1.26.

Pronotum transverse, 1.65 times wider than long, convex, with sides subparallel in basal half; posterior angles weakly protruding; as wide as anterior region of elytra. Elytra oval, weakly convex and narrowing slightly posteriorly, with scarcely rounded tip; transverse striae quite noticeable, as close together as those of pronotum and slightly oblique. Anterior tibiae robust in anterior region; protarsi dilated, first tarsomere 1.10 times narrower than the apical region of the tibiae (Fig. 3).

Genital segment as long as wide, spiculum gastrale with median branch of anterior region very wide, bearing three lobes, one central and two lateral ones; the two lateral branches of the posterior region strongly arcuate (Fig. 4).

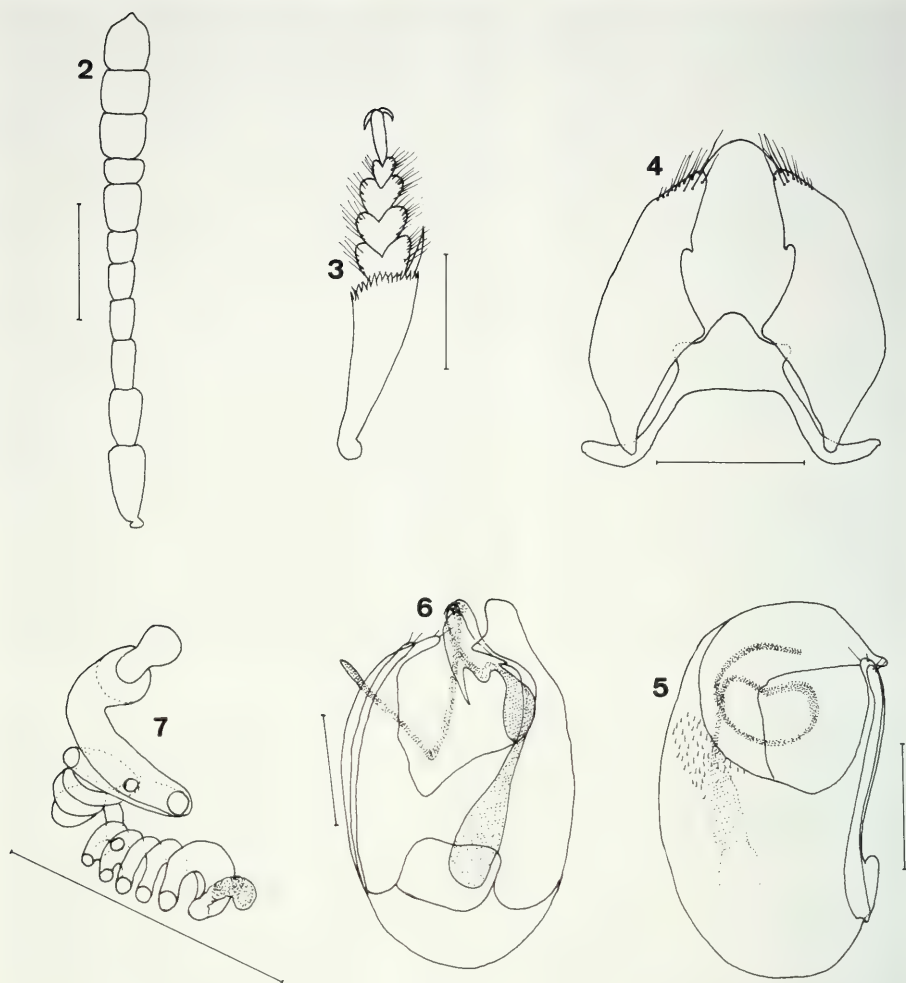
Aedeagus wide, 1.65 times longer than wide and belonging to the ultraevolved group (Szymczakowski, 1961). In lateral view (Fig. 5), with very large, oval apical orifice, closed by the two strongly curved asymmetrical lobes. Left lobe narrow and highly developed, with two apical setae; right lobe arcuate, much more developed than left one, narrowing to a pointed tip. Parameres fused with median lobe, left one differentiated in apical region bearing two inserted short setae very close together. Stylet or flagellum of internal sac very long and spiral-shaped, much more expanded in basal region. Right anterior median region of median lobe with numerous microsetae (Fig. 5). In ventral view, right lobe peak-shaped and flagellum long and wide in median region, forming folds, and end region filiform (Fig. 6).





PLATE 1

Fig. 1. Habitus of *Adelopsis catarina* sp. n. (body length, 2.80 mm); Fig. 8. Habitus of *Adelopsis curvipes* sp. n. (body length, 2.75 mm); Fig. 29. Habitus of *Parapaulipalpina giachinoi* sp. n. (body length, 1.45 mm); Fig. 36. Habitus of *Eucatops (Eucatops) troglodytes* sp. n. (body length, 3.05 mm).



FIGS 2-7

*Adelopsis catarina* sp. n. 2. Antenna; 3. Protarsus male; 4. Genital segment, ventral view; 5. Aedeagus, lateral-left view; 6. Aedeagus, ventral view; 7. Spermathecal complex. (Scale bars: 0.20 mm).

**FEMALE.** Generally smaller, though with the same external morphological characters as the male, except for the slender protarsi.

Spermathecal complex with the spermatheca around 3.5 times longer than wide, weakly expanded in anterior region and wider than apical lobe which is blunt at tip, narrowing in median region; highly complex posterior region, formed by numerous spires (9-10), posterior ones slightly wider and set out in arches (Fig. 7).

**Discussion.** The most similar species to *Adelopsis catarina* sp. n. is *A. triangulifera* Szymczakowski, 1961, captured in the same locality, and although the new taxon is larger, the body shape, striation, antennae and protarsi are the same. However,

examination of the holotype reveals enormous differences between the two species in the spiculum gastrale of the genital segment and in the shape of the aedeagus, with the two parameres clearly differentiated and the large apical orifice in the new species.

The structure of the aedeagus belongs to the ultrarevolved group species, including *Adelopsis asper* Jeannel, 1936, *A. asperoides* Szymczakowski, 1963, *A. bernardi* Portevin, 1923, *A. grouvellei* Jeannel, 1936, *A. insolita* Szymczakowski, 1961, *A. leo* Gnaspini, 1993 and *A. piruapuera* Gnaspini, 1993, all with a large apical orifice in the aedeagus. However, *A. catarina* shows some similarity in the shape of the lobules with *A. insolita*, though is noticeably different when compared with the holotype of the latter species. Also, the general shape of the aedeagus is similar to *A. bernardi* and *A. grouvellei*, however the genitalia of these two species was examined in this study and the differences between *A. catarina* are in the shape and direction of the parameres and of the left and right lobes, and also the lack of microsetae on the median lobe. In conclusion, besides the differentiating characters observed in the aedeagus with regard to the shape of the lobes and the number of setae, those observed in the spiculum gastrale of the genital segment and in the spermathecal complex should also be added as they make this new taxon unmistakable.

*Etymology.* The name is a noun in apposition referring to the Brazilian state where a great diversity of species belonging to the genus *Adelopsis* is found.

### *Adelopsis curvipes* sp. n.

*Type material.* Holotype, ♂. Nova Teutônia, Santa Catarina State (Brazil), V.1977, Fr. Plaumann leg. (MHNG).

*Diagnosis.* Length: 2.75 mm. Wide body. Apical club of antenna flattened, segments clearly transverse. Right lobe of aedeagus developed and pentagonal, with membranous protuberance in mid apical region. Left paramere with apical region curved outwards and bearing three setae, right paramere with five setae.

*Description.* MALE. Length: 2.75 mm; width: 1.45 mm Metathoracic wings fully developed. Slightly ovoid; wide and robust appearance; maximum width in anterior sixth of elytra (Plate 1: Fig. 8). Shiny dark brown body. Pubescence golden, short, fine and laid back. Transverse striolae visible on head, prothorax and elytra, with no other punctuation.

Head 1.65 times narrower than pronotum; eyes developed. Antennae quite robust, surpassing posterior margin of pronotum and 3.10 times shorter than body; first five segments yellowish, the following ones darker in colour; 6<sup>th</sup> segment slightly wider than long, 3<sup>rd</sup> shorter than 2<sup>nd</sup>; antennal club with segments flattened and transverse, even 11<sup>th</sup>, which ends in a whitish membranous structure (Fig. 9). Using the length of the 9<sup>th</sup> segment as a basis, relative length of each segment from 1<sup>st</sup> to 11<sup>th</sup>: 1.40-1.13-1.00-0.75-0.70-0.65-1.04-0.50-1.00-0.95-1.50. Similarly, the proportions between the length and width of each club segment, from 7<sup>th</sup> to 11<sup>th</sup>: 1.03-0.50-0.84-0.76-0.98.

Pronotum transverse, 2.00 times wider than long, base scarcely narrower in anterior region of elytra; sides weakly blunt in anterior half, almost rectilinear in posterior half; posterior angles acute, but weakly pointed; transverse striolae quite fine and close together, slightly undulate, more marked than those on the head. Elytra elongate,



weakly convex, with apical region widely arcuate, slightly truncate; 2.50 times pronotal length, 1.25 times longer than wide; transverse striolae spaced further apart than on pronotum, weakly oblique, areas between them smooth. Anterior tibiae short and expanded in apical region; protarsi dilated, first tarsomere 1.35 times narrower than maximum width of protibia (Fig. 10). Median tibiae slightly arcuate and posterior ones straight, both robust at end.

Aedeagus, in lateral view (Fig. 11), slightly curved in ventral face, with very symmetrical tip, bearing three differentiated lobes set out at different levels, two bearing a short seta and the third with microsetae; right paramere slightly dilated before tip, pointed at tip, with 5 setae of unequal length inserted in apical region. In dorsal view (Fig. 12), apical orifice of median lobe displaced towards the left, and feebly developed; completely lacking left lobe; right lobe highly developed, forming transverse pentagonal plate, without visible setae, and with protruding, more membranous anterior median region. Parameres laterally joined along entire length of median lobe, except for the apical area of the left paramere which is curved outwards and surpasses the apical orifice of the median lobe, where three equidistant setae are inserted. Internal sac with robust curved stylet which appears to be resting on a rectangular sclerotized plate.

FEMALE not known.

*Discussion.* In many species of the genus *Adelopsis* the apical area of the right lobe is triangular, rectangular or pentagonal, for example: *Adelopsis bellatrix* Szymczakowski, 1968; *A. galea* Gnaspini & Peck, 1996; *A. heterocera* Portevin, 1907; *A. onorei* Salgado, 2002; *A. palata* Gnaspini & Peck, 2001; *A. peruviansis* Blas, 1980 and *A. santamarta* Gnaspini & Peck, 2001. Differences in the shape of the mid apical region of the membranous right lobe, the absence of a left lobe and the number and layout of the setae on the parameres make *A. curvipes* sp. n. easily distinguishable by the general structure of the aedeagus in all the previously-mentioned species.

Greater similarity to *A. brunnea* Jeannel, 1936, from Colombia, and its different subspecies from Venezuela, all collected in caves (Szymczakowski, 1975) and to *A. chapadaensis* Salgado, 1999, from Mato Grosso, Brasil, is observed in the structure of the right lobe. Differences in external morphology between these two species and *A. curvipes* sp. n. are observed in the size, *A. curvipes* is larger and wider. The aedeagus of the new taxon is differentiated from *A. brunnea* and *A. chapadaensis* by the membranous protuberance in the mid apical area of the right lobe, and from *A. chapadaensis* by the lack of setae on the right lobe in dorsal view; it is also differentiated from these two species by its length, shape, apical position and number of setae on the parameres.

*Etymology.* The specific name refers to one of the diagnostic characters of the species, the apical curvature of the left paramere.

### *Adelopsis ascutellaris* (Murray, 1856)

*Material examined.* 12 km N Luepa, Gran Sabana, Bolívar Province (Venezuela). 2 ♀♀, 1/11-VII-1987, S. & J. Peck leg. (MHNG).

*Description.* FEMALE. 2.00 mm long, with very weakly arcuate pronotal sides; antennal segments with 6<sup>th</sup> transverse, 2<sup>nd</sup> as long as the sum of 3<sup>rd</sup> and 4<sup>th</sup> segments

together. The spermathecal complex is formed by an elongate oblong apical lobe, as wide as anterior region of spermatheca which is elongate and of similar width; the posterior region of the spermathecal complex is formed by 4 turns of equal thickness (Fig. 13). See Jeannel (1936) for the description of other structures.

*Distribution.* The only record known to date is from Caracas D.F. (Venezuela) (Jeannel, 1936), the record from Bolívar Province is now made for the first time.

***Adelopsis asperoides* Szymczakowski, 1963**

*Material examined.* Nova Teutônia, Santa Catarina State (Brazil). 1♂-1♀, IV-1976; 2♂♂-3♀♀, V-1976; 1♂-1♀, XII-1976; 1♂, I-1977; 1♀, VI-1977, Fr. Plaumann leg. (MHNG and CPMG).

*Description.* Length 2.15-2.40 mm. Male genital segment as long as wide, spiculum gastrale with median branch of anterior region around 2.5 times longer than wide and with parallel sides; lateral branches of posterior region long, narrow and slightly arcuate (Fig. 14).

Spermathecal complex with spermatheca about four times longer than wide, of uniform thickness and weakly arcuate shaped; apical lobe ovoid and protruding; posterior region coiled with two-three turns (Fig. 15).

For the description of other structures and also figures see Szymczakowski (1963) and Gnaspini (1993).

*Distribution.* This species is known from Sao Paulo and Minas Gerais States (Brazil), (Peck *et al.*, 1998). The record from Santa Catarina State is new for Brazil.

***Adelopsis bernardi* Portevin, 1923**

*Material examined.* Nova Teutônia, Santa Catarina State (Brazil). 1♂-1♀, III-1976; 6♂♂, IV-1976; 2♂♂, V-1976; 4♂♂-2♀♀, XII-1976; 1♂-1♀, I-1977; 3♂♂-1♀, V-1977; 2♂♂-1♀, VI-1977, Fr. Plaumann leg. (MHNG and CPMG).

Arroyo Itabo, Guazu, Alto Paraná Province (Paraguay). 1♂, 4-XI-1979, Expedition Muséum de Genève leg. (MHNG).

*Description.* Size 2.20-2.50 mm. Male genital segment as long as wide; spiculum gastrale with median brach of anterior region as wide as long, slightly angulose at tip; lateral branches of posterior region narrow, long and almost straight (Fig. 16).

Spermathecal complex with spermatheca of uniform thickness, bearing an arch dorsally and four times longer than wide, with apical lobe and wider than anterior region of spermatheca; posterior region coiled with four turns (Fig. 17).

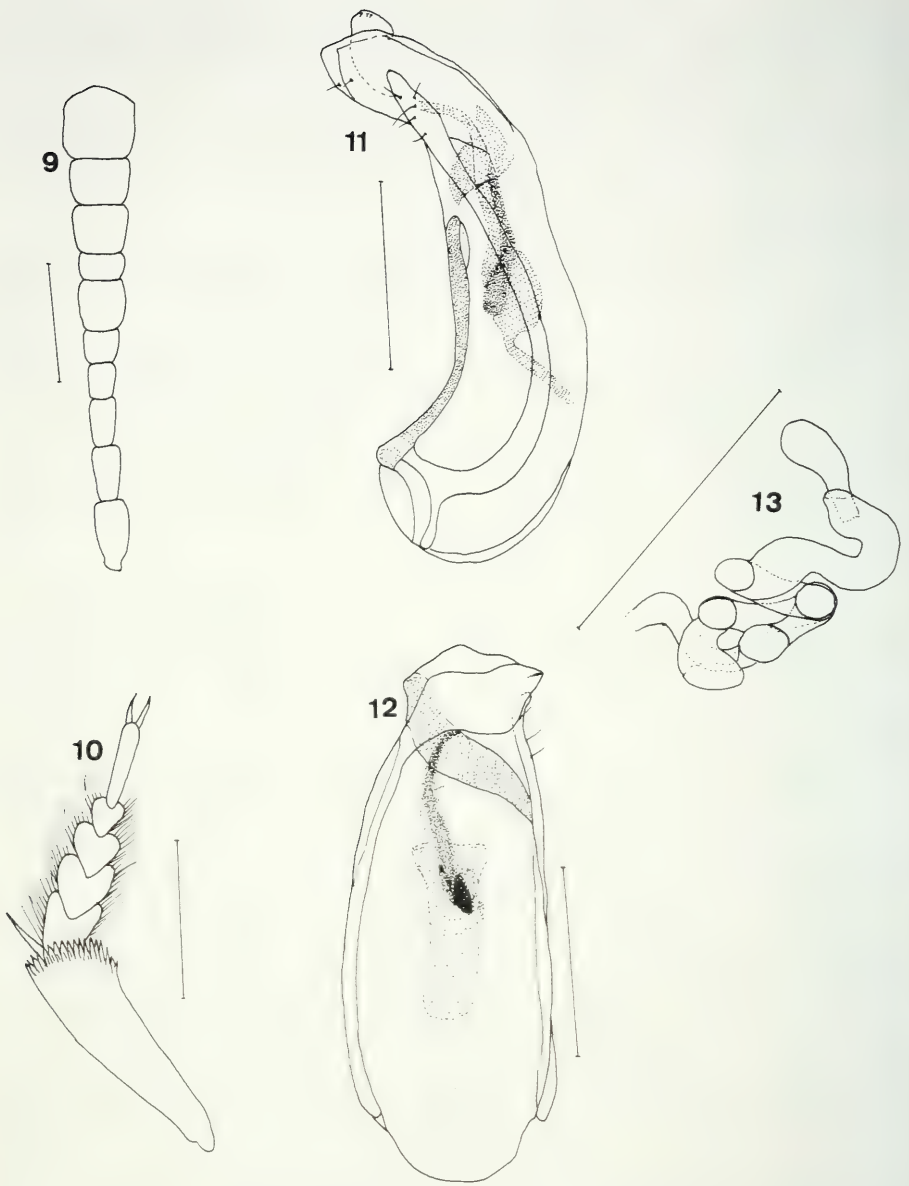
See Jeannel (1936) and Szymczakowski (1963) for the description of other structures and illustrations.

*Distribution.* Teresópolis, Rio de Janeiro State (Brazil). The record from Santa Catarina State is new for Brazil.

***Adelopsis grouvellei* Jeannel, 1936**

*Material examined.* Nova Teutônia, Santa Catarina State (Brazil). 1♂, III-1976; 1♂-4♀♀, IV-1976; 2♂♂-1♀, V-1976; 2♀♀, XII-1976; 3♂♂, I-1977; 1♂-1♀, V-1977; 3♂♂, VI-1977; 1♀, IX-1978, Fr. Plaumann leg. (MHNG and CPMG).

*Description.* Size 2.10-3.00 mm. Male genital segment somewhat wider than long, spiculum gastrale with median branch of the anterior region arcuate and wider



Figs 9-13

*Adelopsis curvipes* sp. n. 9. Antenna; 10. Protarsus male; 11. Aedeagus, lateral-right view; 12. Aedeagus, dorsal view. *Adelopsis ascutellaris*. 13. Spermathecal complex. (Scale bars: 0.20 mm).



than long; lateral branches of posterior region long and slightly curved upwards (Fig. 18).

Spermathecal complex with arcuate spermatheca, wider in anterior region, apical lobe with anterior region blunt and wider than the anterior region of the spermatheca; posterior region formed by numerous superposed turns of uniform thickness (Fig. 19).

See Jeannel (1936) and Szymczakowski (1963) for the description of other structures and also graphs.

*Distribution.* Recorded from Bahía, Paraná, Río de Janeiro and Sao Paulo States (Brazil) by Szymczakowski (1963) and Peck *et al.* (1998). The record from Santa Catarina State is new for Brazil.

### *Adelopsis insolita* Szymczakowski, 1961

*Material examined.* Nova Teutônia, Santa Catarina State (Brazil). 1 ♂, IV-1976; 1 ♀, VI-1977, Fr. Plaumann leg. (MHNG).

*Description.* Size 2.00-2.50 mm. The aedeagus observed in the holotype has a very large apical orifice; very long and strongly undulate stylet, and curved asymmetrical parameres. Spiculum gastrale with median region wider than long and no anterior branch is observed, unlike in the other species, the lateral branches of the posterior region are long, straight and narrow, though feebly dilated in apical region (Fig. 20).

The spermathecal complex is not described as it is absent in the studied female specimen.

See Szymczakowski (1961) for extensive description and for illustrations.

*Distribution.* This species has only been recorded in Nova Teutônia, Santa Catarina State (Brazil).

### *Adelopsis luculenta* Szymczakowski, 1963

*Material examined.* Nova Teutônia, Santa Catarina State (Brazil). 2 ♂♂-2 ♀♀, IV-1976; 1 ♂-1 ♀, V-1976; 1 ♂, XII-1976, Fr. Plaumann leg. (MHNG and CPMG).

*Description.* Size 2.60-3.70 mm. Male genital segment wider than long, spiculum gastrale with median branch of anterior region wider than long, weakly angulose at the tip, the two lateral branches of the posterior region slightly curved (Fig. 21). This structure is similar in shape to *A. bernardi*, but the spiculum gastrale in this species is less robust than in *A. luculenta* (Fig. 16).

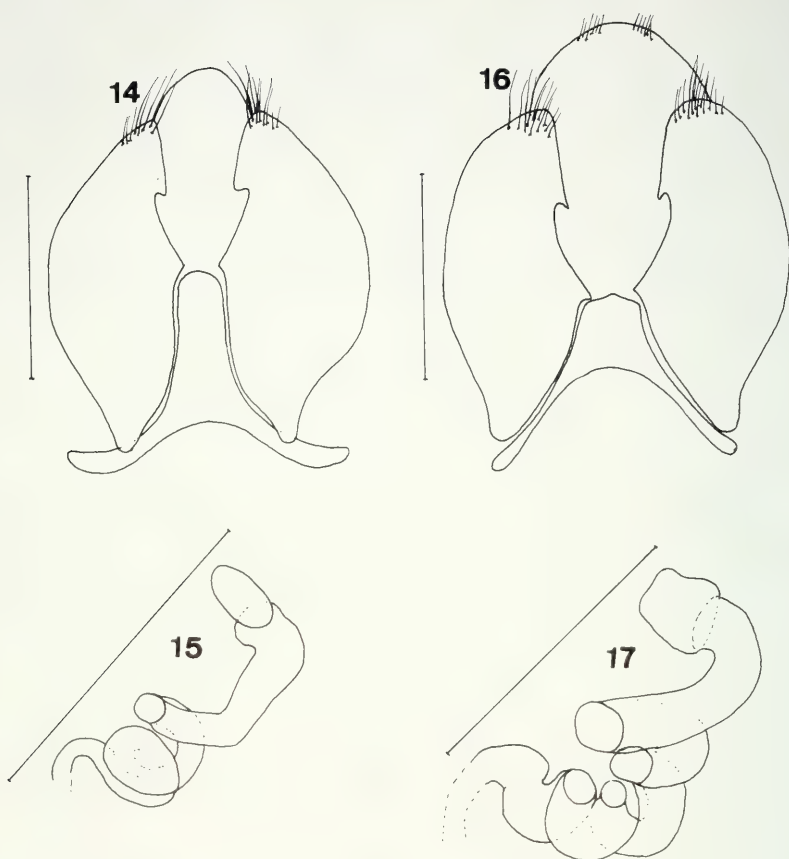
Spermathecal complex with anterior region of spermatheca strongly expanded; apical lobe oval, weakly blunt at the tip; posterior region formed by two robust turns (Fig. 22).

See Szymczakowski (1963) for extensive description and for illustrations.

*Distribution.* Only the record for Sao Paulo State is known, its distribution has now been extended to Santa Catarina State.

### *Paulipalpina claudicans* (Szymczakowski, 1980)

*Material examined.* Nova Teutônia, Santa Catarina State (Brazil). 112 ♂♂-129 ♀♀, captured in III-1976, IV-1976, V-1976, XII-1976, I-1977, V-1977, VI-1977, Fr. Plaumann leg. (MHNG and CPMG).



FIGS 14-17

*Adelopsis asperoides*. 14. Genital segment, ventral view; 15. Spermathecal complex. *Adelopsis bernardi*. 16. Genital segment, ventral view; 17. Spermathecal complex. (Scale bars: 0.20 mm).

**Description.** Size 2.00-2.30 mm. Male genital segment as long as wide, spiculum gastrale narrow, long and straight (Fig. 23).

Spermathecal complex with small lobe in mid anterior region of spermatheca in a widely arcuate shape which narrows progressively; posterior region formed by numerous superposed turns and ending in a structure resembling a flattened lobe (Fig. 24).

See Szymczakowski (1980) for extensive description and for illustrations.

**Distribution.** Only data from Nova Teutônia, Santa Catarina State (Szymczakowski, 1980) and from Río de Janeiro State (Salgado, 1999) are known.

***Parapaulipalpina giachinoi* sp. n.**

**Type material.** Holotype, 1♂. Samiria, Loreto Province (Perú). 28-X/8-XI-1980, Cl. Vaucher leg. (MHNG).

**Diagnosis.** Length, 1.45 mm. Antennal club segments transverse, except for 11<sup>th</sup>. Aedeagus very long and narrow, with lateral margins slightly undulate. Lobes of apical region of aedeagus touching, both robust, especially the right one. Flagellum as long as median lobe.

**Description.** MALE. Length, 1.45 mm; width, 0.75 mm. Metathoracic wings fully developed. Body ovoid, quite elongate (Plate 1: Fig. 29). Shiny reddish colour, legs lighter in colour with whitish protarsi and pale yellow antennae, except for slightly darker 7<sup>th</sup> to 10<sup>th</sup> segments. Pubescence very short, fine golden and laid back. Eyes developed. Maxillary palps with final segment very fine, pointed and around twice as short as penultimate.

Antenna 1.30 times as long as pronotum, almost reaching base of pronotum (Fig. 25); 8<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> club segments weakly transverse, 4<sup>th</sup> also transverse; in lateral view, last segment ventrally concave, forming a small pointed lamina. Using the length of the 9<sup>th</sup> segment as a basis, relative length of each segment from 1<sup>st</sup> to 11<sup>th</sup>: 1.48-1.50-0.80-0.60-0.70-0.70-1.10-0.50-1.00-1.00-1.60. Proportions between length and width of each club segment, from 7<sup>th</sup> to 11<sup>th</sup>: 1.36-0.60-0.98-0.95-1.85.

Pronotum strongly transverse, 2.25 times as wide as long, maximum width in posterior angles which are acute and protruding posteriorly; sides uniformly rounded, basal edge weakly sinuous; transverse striae clearly visible and quite close together. Elytra together 1.35 times as long as wide, the same width as the posterior region of the pronotum; sides weakly arcuate, apical edges wide, subtruncate; transverse striae clearly defined and further apart than those on the pronotum. Anterior tibiae simple, about 3.5 times longer than wide, anterior tarsi dilated, 0.60 times as wide as maximum width of tibia (Fig. 26). Metafemur bearing a small tubercle near the middle at the posterior margin (Fig. 27).

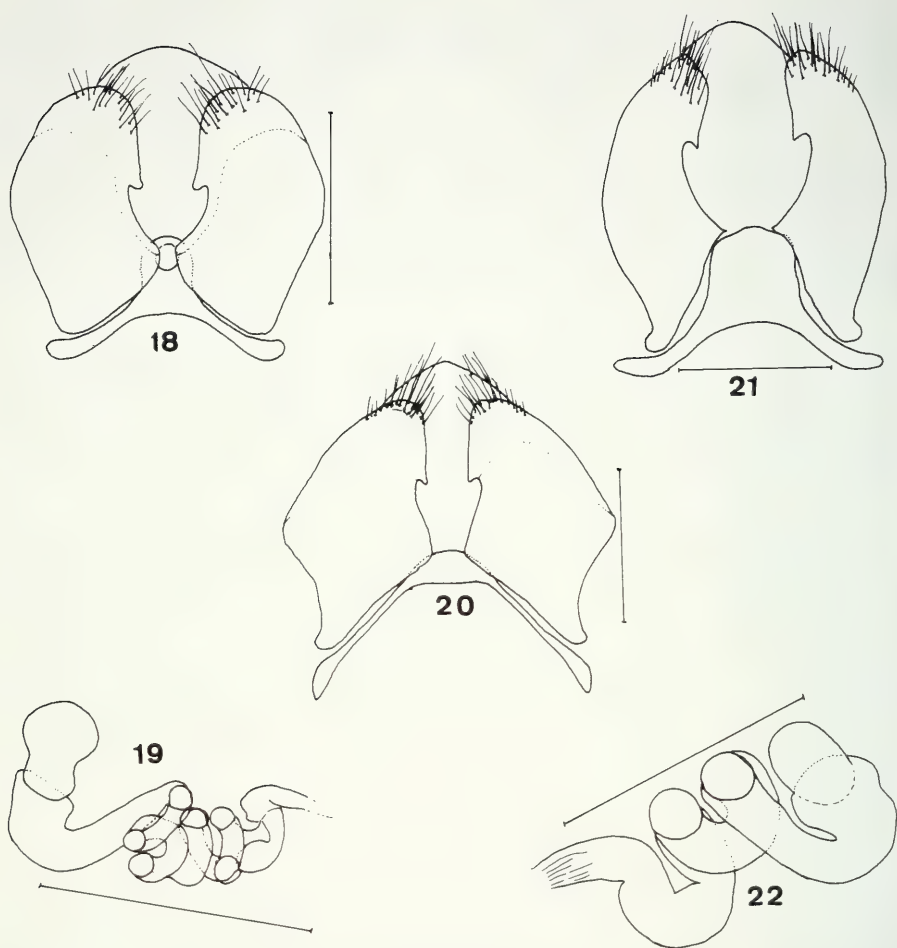
Genital segment with lobes of sternite together as long as wide; spiculum gastrale very straight and long, as long as sternite (Fig. 28).

Aedeagus very long and narrow, 5 times longer than wide. In dorsal view (Fig. 30), with sides slightly undulate; apical orifice oval, small completely closed by two lobes of median lobe which are unequal and short, the right one being more robust and blunt, with 4-5 small setae inserted; left lobe with truncate tip and one small seta. In lateral view (Fig. 31), on ventral side median lobe uniformly curved, dorsally with two curvatures, one anterior and concave and the other posterior, longer and convex; apex forming very characteristic point bearing four small setae and dorsal hump; internal sac enclosing heliocoidal membranous structure, and a long flagellum. Parameres scarcely visible, joined to whole length of median lobe. Internal sac with stylet or flagellum very long and undulate, as long as aedeagus (note: when extracting the holotype genitalia the end section of the less sclerotized stylet may have broken off); no other structures visible.

FEMALE unknown.

**Discussion.** *Parapaulipalpa giachinoi* sp. n. is included in the genus *Parapaulipalpa* due to the short antennae, slightly elongate antennal segments, aedeagus somewhat S-shaped in dorsal view and the stylet very elongate. The only two species in the genus, *Parapaulipalpa dentata* Gnaspini, 1996, from Venezuela, and *P. filicornis* (Jeannel, 1936), from Colombia, *P. giachinoi* sp. n. are easily differentiated





Figs 18-22

*Adelopsis grouvellei*. 18. Genital segment, ventral view; 19. Spermathecal complex. *Adelopsis insolita*. 20. Genital segment, ventral view. *Adelopsis luculenta*. 21. Genital segment, ventral view; 22. Spermathecal complex. (Scale bars: 0.20 mm).

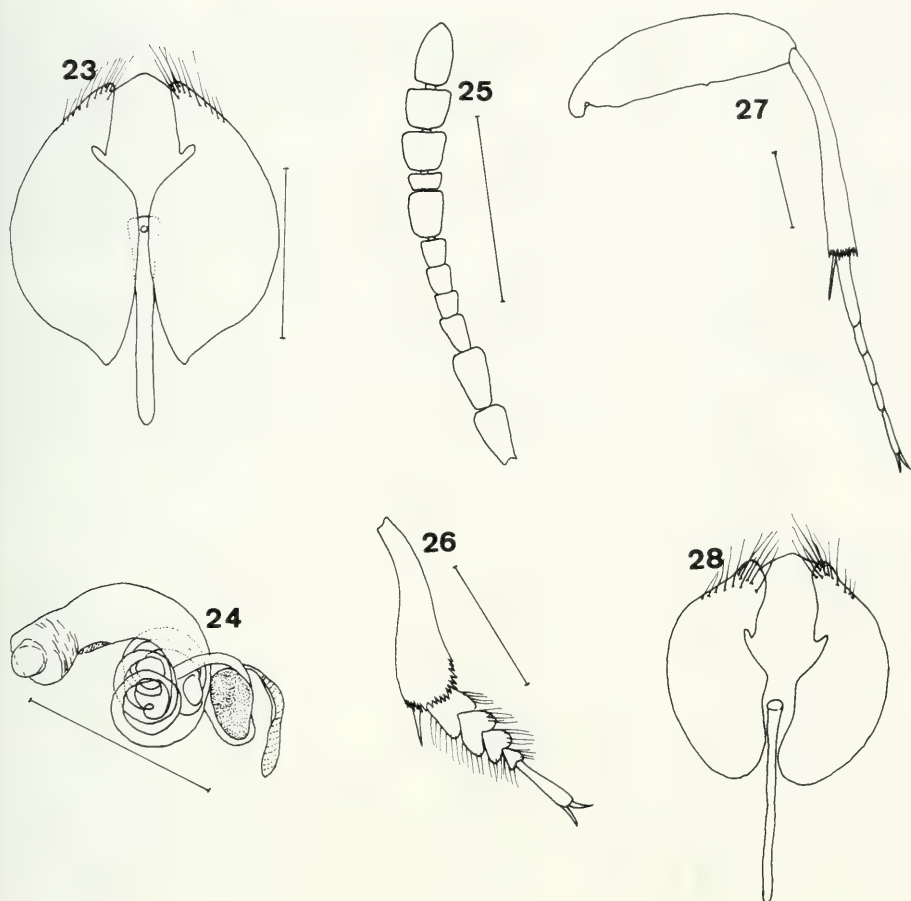
by: smaller body size, antennal club segments more transverse, aedeagus less curved in dorsal view and, in particular, the two lobes closing the apical orifice more dilated and rounded.

This is the first record of the genus *Parapaulipalpina* in Peru.

*Etymology*. This species is named after the entomologist Dr Pier Mauro Giachino, in recognition of his extensive research work in the study of the families Leiodontidae and Carabidae.

***Ptomaphagus (Adelops) spelaeus* (Bilimek, 1867)**

*Material examined*. Cacahuamilca Cave, Guerrero State (Mexico). 1♂-1♀, 16-IV-1981, Strinati leg. (MHNG).



FIGS 23-28

*Paulipalpina claudicans*. 23. Genital segment, ventral view; 24. Spermathecal complex. *Parapaulipalpina giachinoi* sp. n. 25. Antenna; 26. Protarsus male; 27. Femur, tibia and tarsi posterior; 28. Genital segment, ventral view. (Scale bars: 0.20 mm).

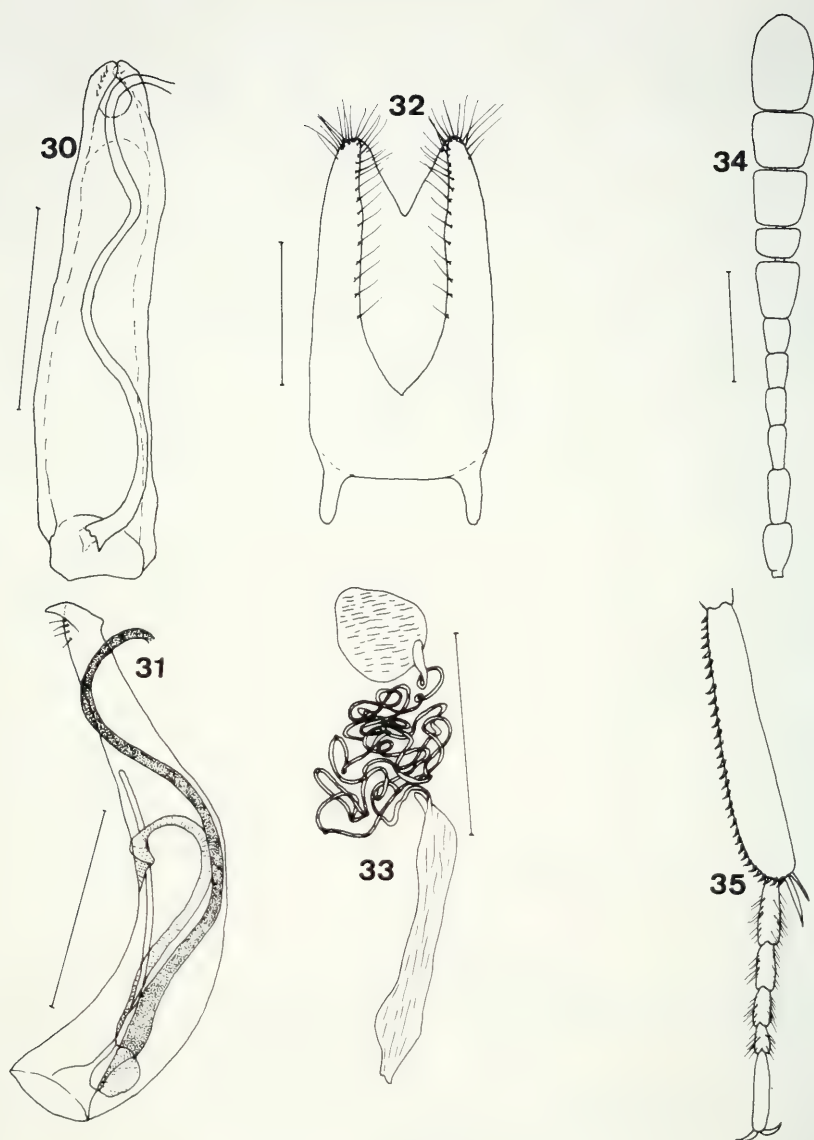
**Description.** Size 3.00 mm. See Peck (1973) for extensive description and for illustrations.

**Distribution.** Troglophil species recorded in Guerrero, Jalisco and Oaxaca States (Mexico), (Peck *et al.*, 1998).

EUCATOPINI JEANNEL, 1921

***Eucatops* (*Eucatops*) *glabricollis* (Reitter, 1884)**

**Material examined.** Nova Teutônia, Santa Catarina State (Brazil). 1 ♀, IV-1976; 1 ♂, V-1976; 3 ♂-3 ♀, XII-1976; 2 ♂-1 ♀, II-1977; 1 ♂-1 ♀, V-1977, Fr. Plaumann leg. (MHNG and CPMG).



FIGS 30-35

*Parapaulipalna giachinoi* sp. n. 30. Aedeagus, ventral view; 31. Aedeagus, lateral-right view. *Eucatops* (*E.*) *glabricollis*. 32. Genital segment, ventral view; 33. Spermathecal complex. *Eucatops* (*E.*) *troglodytes* sp. n. 34. Antenna; 35. Protarsus male. (Scale bars: 0.20 mm).

**Description.** Size 1.80-2.60 mm. Male genital segment subcylindrical, 1.90 times as long as wide, with 8-10 setae in the inner ventral margin (Fig. 32).

Spermathecal complex exhibiting a globose spermatheca, a very long and very fine spermathecal duct forming a jumble of turns and a weakly-defined membranous elongate final region (Fig. 33).



See Jeannel (1936) for extensive description and for illustrations.

*Distribution.* This species was mentioned by Blumenau, Santa Catarina State (Szymczakowski, 1963), Sao Paulo State (Jeannel, 1936) and Alagoas and Pará States (Salgado, 1999).

*Eucatops (Eucatops) troglodytes* sp. n.

*Type material.* Holotype ♂, Grotte de Caiman, Route de Kaw, French Guiana, 2-VIII-1987, C. Juberthie leg. (CPMG). Paratypes: 5 ♂♂, same data as holotype. (Collections: 1 ♂, MHNG; 3 ♂♂, CPMG and 1 ♂, CJSC).

*Diagnosis.* Length, 2.75-3.15 mm. Antennae with the 2<sup>nd</sup> segment somewhat longer than the 3<sup>rd</sup>; 8<sup>th</sup> to 10<sup>th</sup> segments weakly transverse. Apical area of elytra not truncate. Protarsi very thin, none of the tarsomeres dilated. Aedeagus with triangular dorsal valve, longer than wide, ventral valve with strongly pointed tip, very narrow and protruding towards ventral face; parameres short, not surpassing tip of dorsal valve, setae quite long and inserted in apical area; stylet not distinguishable amongst sclerotized pieces; basal lamina long, with ventral median carina and convex posterior margin.

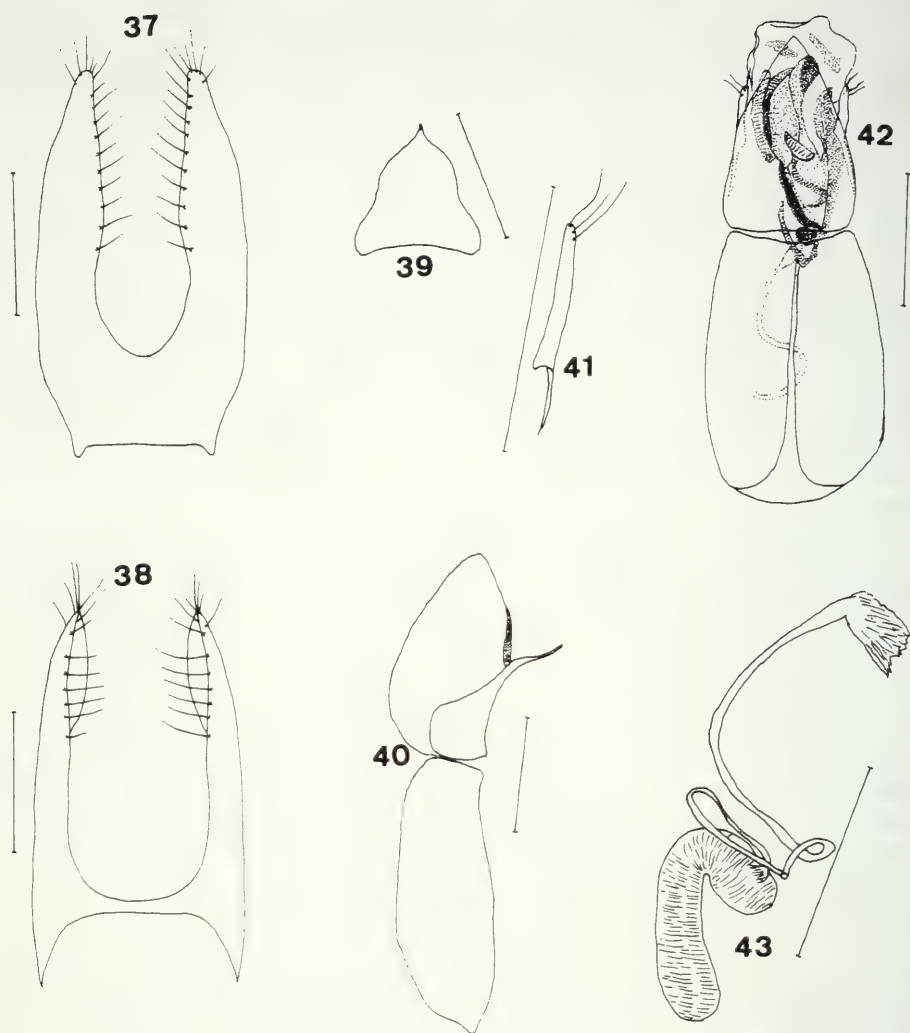
*Description.* MALE. Holotype. Length, 3.05 mm; width, 1.80 mm (Paratypes: length 2.95-3.15 mm; width, 1.72-1.90 mm). Metathoracic wings fully developed. Strongly convex body (Plate 1: Fig. 36). Eyes developed. Very shiny reddish-brown colour. Pubescence very fine, laid back and yellowish. Punctuation on head somewhat stronger than on pronotum, fine in both cases, very abundant, with points clearly distant and surface smooth.

Antennae clearly longer than pronotum, 0.39 times length of body (Fig. 34); club segments progressively expanding towards the apical area, 8<sup>th</sup> segment slightly transverse and 9<sup>th</sup> and 10<sup>th</sup> segments as long as wide; also, 4<sup>th</sup> to 6<sup>th</sup> segments of equal length, 2<sup>nd</sup> being slightly longer than 3<sup>rd</sup> and as long as 1<sup>st</sup> using the length of the 9<sup>th</sup> segment as a basis, relative length of each segment from 1<sup>st</sup> to 11<sup>th</sup>: 1.02-1.04-0.84-0.64-0.64-0.64-1.04-0.60-1.00-1.02-1.80. Proportions between length and width of each club segment from 7<sup>th</sup> to 11<sup>th</sup>: 1.30-0.76-1.00-0.98-1.54.

Pronotum campaniform, strongly transverse, 2.25 times wider than long; lateral margins slightly sinuate in posterior region; basal region as wide as anterior region of elytra; posterior angles pointed. Maximum width of elytra in anterior fourth, 1.15 times longer than wide; apical area of elytra not truncate, but slightly pointed and arch shaped; transverse striation clearly visible, defined by well defined points, striae separate and not in continuous curve. Legs long and slender. Protarsi very fine and long, none of the tarsomeres dilated, and much narrower than protibiae which are also slightly expanded (Fig. 35). Posterior femurs lacking spine or tubercle in posterior margin. Posterior tibiae not arcuate, with first metatarsomere shorter than following two together; internal metatibial spur slightly longer than first metatarsomere.

Genital segment twice as long as wide, with 9-10 setae in internal margins of lobes of sternum anterior apical setae (Fig. 37), and 6 setae longer than sternal ones on margins of lobes of tergum (Fig. 38).

Aedeagus with both valves of median lobe shaped very differently; dorsal valve longer than wide, triangular and larger than ventral one; ventral valve with undulate lateral margins, tip elongate and strongly pointed and sharp, also, in lateral view tip



Figs 37-43

*Eucatops (E.) troglodytes* sp. n. 37. Genital segment, ventral view; 38. Genital segment, dorsal view; 39. Ventral valva of aedeagus; 40. Aedeagus, lateral view; 41. Left paramere, latero-dorsal view; 42. Aedeagus and inner sac, dorsal view. *Eunemadus chilensis*. 43. Spermathecal complex. (Scale bars: 0.20 mm).

separated from median lobe, slightly curved and protruding towards ventral (Figs. 39 and 40). Parameres short and weakly robust, not surpassing tip of dorsal valve, bearing 3 fairly long setae inserted in apical region (Fig. 41). Internal sac as long as dorsal valve, with numerous sclerotized pieces; stylet is not differentiated. Basal lamina longer than dorsal valve and clearly longer than wide, with strongly convex posterior margin; also exhibiting a weakly defined carina mid ventrally (Fig. 42).

FEMALE unknown.

**Variability.** Differences have only been observed in the number of setae in the apical area of the parameres, as some paratypes have 4 or 5 setae, which are always long and all inserted in the apical area. The varying number of setae on the parameres appears to be frequent in species belonging to *Eucatops* (Salgado, 2003).

**Discussion.** *Eucatops* (*E.*) *troglydites* sp. n. resembles *Eucatops* (*E.*) *oblongus* Portevin, 1903, from Perú, in the number of setae inserted in the apical area of the parameres, and *Eucatops* (*E.*) *formicetorum* (Bruch, 1918) from Argentina, in the elongate pointed shape of the valves and the short parameres which do not surpass the tip of the valves. However, the shape of the protarsi and many of the characters of the aedeagus, in particular the shape and position of the ventral valve, clearly separate this new taxon from any other species in the genus *Eucatops*.

**Ecology.** To date, this is the first record of a *Eucatops* being captured inside a cave. Due to their developed eyes, large wings and pigmentation, the specimens of this species should be considered troglophil. They were found in the anterior part of the cave, feeding on organic material.

**Etymology.** The specific name, an invariable epithet, refers to the tendency of the specimens to colonize caves.

ANEMADINI HATCH, 1928

***Eunemadus chilensis* Portevin, 1914**

**Material examined.** Argentina: El Bolsón, 150 m altitude, Río Negro Province; 1 ♀, 7-I-1996, M. Etonti leg. (CPMG). Golondrinas, Chubut Province; 1 ♀, 15-IX-1981, Kovacs leg. (MHNG).

Chile: Tolhuaca, Malleco Province; 2 ♀ ♀, I-1987 (CPMG).

**Description.** FEMALE. Size: 2.90-3.60 mm. Very characteristic spermathecal complex formed by sacciform spermatheca, lacking differentiated lobes, around five times longer than wide with quite clear superficial striation. Long, fine spermathecal duct inserted in basal region, approximately three times longer than spermatheca, which expands slightly at the end (Fig. 43).

See Jeannel (1957, 1962) for extensive description and for illustrations.

**Distribution.** The species has been recorded in Argentina, Río Negro Province, and now in Chubut Province; and various provinces in Chile, such as Chiloé, Concepción, Llanquihue and Santiago. New for the Malleco Province.

***Dissochaetus hetschkoi* Reitter, 1884**

**Material examined.** Nova Teutônia, Santa Catarina State (Brazil). 85 ♂ ♂-46 ♀ ♀ captured in I-1977, II-1977 and V-1977, Fr. Plaumann leg. (MHNG and CPMG).

**Description.** See Gnaspini (1991) and Salgado (1991a) for extensive description and for illustrations.

**Distribution.** This is a widely distributed species, known from Belize, Brazil, Mexico and Venezuela (Peck *et al.*, 1998).

***Dissochaetus murrayi* Reitter, 1884**

**Material examined.** Nova Teutônia, Santa Catarina State (Brazil). 49 ♂ ♂-63 ♀ ♀ captured in I-1977, II-1977 y V-1977, Fr. Plaumann leg. (MHNG and CPMG).

**Description.** See Gnaspini (1991) and Salgado (1991a) for extensive description and for illustrations.



*Distribution.* Known from the south eastern Neotropical region, with records from Paso de los Libres, Corrientes Province (Argentina) (Salgado, 1991a) and several states in Brazil (Peck *et al.*, 1998).

***Dissochaetus parallelus* Portevin, 1921**

*Material examined.* 400 m, 35 km N Altagracia, Miranda Province (Venezuela), 2 ♀ ♀, 7-14-VI-1987, S. & J. Peck leg. (MHNG).

*Description.* See Jeannel (1936) for extensive description and for illustrations.

*Distribution.* To date, only known from the type locality, El Simón, Caracas D.F. (Venezuela).

***Dissochaetus villosus* Szymczakowski, 1961**

*Material examined.* Nova Teutônia, Santa Catarina State (Brazil). II-1977, 9 ♂ ♂-3 ♀ ♀, Fr. Plaumann leg. (MHNG and CPMG).

*Description.* See Szymczakowski (1961) and Gnaspini (1991) for extensive description and for illustrations.

*Distribution.* This species is endemic in Brazil and known from Minas Gerais, Paraná and Sao Paulo. New for the Santa Catharina State.

***Nemadiolus (Subnemadiolus) kuscheli* Jeannel, 1962**

*Material examined.* Ushuaia, Monte Susana, Tierra de Fuego Province (Argentina). 1 ♂, 26-III-1975, E. Horak leg. (MHNG).

*Description.* See Jeannel (1962) and Salgado (1991b, 2000) for extensive description and for illustrations.

*Distribution.* Jeannel (1962) describes this species from specimens from Chepu, Chiloé Province. Salgado (1991b, 2000) recorded it from several provinces including Aisén, Cautín, Chiloé, Concepción, Llanquihue, Magallanes, Malleco, Ñuble, Osorno, Palena, Talca and Valdivia, all in Chile. The record from Tierra de Fuego Province extends its distribution area to Argentina, from where it is recorded for the first time.

**CAMIARINAE JEANNEL, 1911**

**AGYRTODINI JEANNEL, 1936**

***Chiliopelates kuscheli* (Jeannel, 1957)**

*Material examined.* Tolhueca, Malleco Province (Chile). 3 ♂ ♂-1 ♀, I-1987 (CPMG).

*Description.* See Jeannel (1962) for extensive description and for illustrations.

*Distribution.* This species is endemic in Chile. It had been recorded from Aisén and Llanquihue provinces (Jeannel, 1957) and is now recorded for the first time from Malleco province.

***Dasypelates nebulosus* (Jeannel, 1957)**

*Material examined.* Tolhueca, Malleco Province (Chile). 1 ♂, I-1987 (CPMG).

*Description.* See Jeannel (1957, 1962) for extensive description and for illustrations.

*Distribution.* This species is endemic in Chile and is only known from Bío Bío Province. The record from Malleco province is now also included.

***Eupelates transversestrigosus* (Fairmaire & Germain, 1859)**

*Material examined.* Golondrinas, Chubut province, 2♀♀, 15-IX-1981, Kovacs leg. (MHNG).

*Description.* See Jeannel (1957 and 1962) for extensive description and for illustrations.

*Distribution.* The species is known from various localities in the southern Neotropical region, Chubut and Río Negro Provinces (Argentina) and Aconcagua, Arauco, Cautín, Chiloé, Concepción, Llanquihue, Ñuble, Santiago and Valdivia Provinces (Chile) (Jeannel, 1962; Salgado, 1991b; Peck *et al.*, 1998).

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## Fruit flies (Diptera, Tephritidae) from Saudi Arabia, with descriptions of a new genus and six new species

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### **Fruit flies (Diptera, Tephritidae) from Saudi Arabia, with descriptions of a new genus and six new species.**

- During a survey of the insect fauna of the Abha area (Aseer province, southwestern part of Saudi Arabia) with Malaise traps 51 species of Tephritidae were recorded, 40 of them being new records for this country. Nine species are not named. The first comprehensive checklist for Saudi Arabia is presented, including 62 species of which 10 species are considered to be pests. *Arabodesis* gen. n., with its type *A. reductiseta* sp. n., is described from Saudi Arabia and Yemen. Further new species are *Neoceratitis flavoscutellata* sp. n. (Saudi Arabia), *Dicheniotes multipunctatus* sp. n. (Kenya, Saudi Arabia, Tanzania, Yemen), *Sphenella setosa* sp. n. (Saudi Arabia), *Tanaica maculata* sp. n. (Ethiopia, Kenya, Saudi Arabia), and *Tanaica pollinosa* sp. n. (Saudi Arabia, South Africa). The status of *Tephritomyia despoliata* Hering and *Trupanea aucta* var. *repleta* Bezzi is discussed. *Sphenella marginata austrina* Munro is synonymized with *S. marginata* s. str. (syn. n.). Keys for the genera of the *Campiglossa* genus group and for the species of *Tanaica* Munro are provided.

**Keywords:** Diptera - Tephritidae - Saudi Arabia - new genus - new species - new synonymy.

## INTRODUCTION

Saudi Arabia is a large country of about 2.15 Million km<sup>2</sup>. Its biogeographical position is quite peculiar as a crossroad of various realms, included in the Palearctic Region which lies primarily in the North (at the border with Jordan), adjacent to the Afrotropical Region in the South West (separated from Eritrea by the narrow Red Sea), and to a lesser extent to the Oriental Region in the South East. It may be expected therefore that its fauna is reflecting this special biogeographical position, and elements of the various realms may be found.

Very little information is available on the Tephritidae fauna of this country although species of this family are usually attractive with patterned wings and bright eyes, easy to collect, often abundant on their host plants, and economically and eco-



gically important. About 100 species of Tephritidae out of about 4500 described species worldwide are known as pests (White & Elson-Harris, 1992). The only comprehensive list of Saudi Arabian Tephritidae containing 12 species was given by Al-Ahmadi & Salem (1999), most of them species which cause damage in fruit plantations. Freidberg & Kugler (1989) added 6 species. Four further species are mentioned in isolated publications. Thus, 22 species are known up to date from Saudi Arabia (Tab. 1). Compared with the diversity of other countries (Tab. 2) it may be anticipated that any research which is not intended to study exclusively pest species will add new species to this list.

In the course of a survey of the insect fauna of the Aseer (= 'Asir') area (south-western part of Saudi Arabia) an important number of Tephritidae was collected by the second author using Malaise traps. After identification of the specimens by the first author it became clear that this collection improves considerably the knowledge on Tephritidae of Saudi Arabia. This paper brings together our present knowledge on its fruit fly diversity. In addition to the results of the identifications all available literature about Tephritidae of Saudi Arabia is summarized.

## MATERIAL AND METHODS

Some 440 specimens of Tephritidae were collected using Malaise traps at 4 sites in South-Western Saudi Arabia by the second author. All sites belong to Aseer (= 'Asir') and are situated between 260 and 2200 m within a radius of about 100 km around the town of Abha. The names of the localities and further information are given in Tab. 3. Abha has the highest rainfall of Saudi Arabia and it is the only region where open forests may grow. Consequently, the region is comparatively heavily populated and most of its surface is cultivated.

In order to resolve some taxonomic questions, about 80 specimens from other countries are included in this study.

The depository of the specimens is as follows:

CHD	collection H. Dawah
FMNH	Finnish Museum of Natural History, Helsinki, Finland
KMMA	Koninklijk Museum voor Midden Afrika, Tervuren, Belgium
MCSNM	Museo Civico di Storia Naturale, Milano, Italy
NHML	Natural History Museum London (= British Museum of Natural History), England
MHNG	Muséum d'histoire naturelle, Genève, Switzerland
NMWC	National Museum of Wales, Cardiff, United Kingdom
SAMCT	South African Museum, Cape Town, South Africa
SMNS	Staatliches Museum für Naturkunde, Stuttgart, Germany
TAU	Tel Aviv University, Israel
ZMUA	Zoological Museum, University of Amsterdam, Netherlands

Most specimens collected during this study are deposited in the MHNG. Duplicates are basically stored in the NMWC, TAU and the CHD except where otherwise mentioned.

TAB. 1

Checklist of Tephritidae of Saudi Arabia. Classification according to Norrbom *et al.* (1999a, b), but species are listed in alphabetical order within the tribe Tephritini. Abbreviations. *Column «Source»*: 1 = Al-Ahmadi & Salem (1999); 2 = Freidberg & Kugler (1989); 3 = Norrbom *et al.* (1999b); 4 = Shalaby (1961); 5 = White & Elson-Harris (1992); 6 = Anonymous (2002); 7 = De Meyer & Freidberg (2005). \* = Identification doubtful as species often misidentified (see also text). *Column «PS»*: Pest status according to White & Elson-Harris (1992). B = Potential species for Biological Control of weed; M = Minor pest species or potential pest species, attacking commercially grown plants; P = Pest species; B, M = Either polyphagous species whose host range include commercially grown species (and therefore considered potential or minor pest) as well as weeds (potential useful species), or a species which is attacking a plant species which is cultivated in some parts of the world and considered to be a pest in others.

no	Name	Source	PS
	Subfamily Trypetinae		
	Tribe Carpomyini		
	Subtribe Carpomyina		
1	<i>Carpomya incompleta</i> (Becker, 1903)	1, present study	P
2	<i>Myiopardalis pardalina</i> (Bigot, 1891)	1	P
	Tribe Dacini		
	Subtribe Ceratitidina		
3	<i>Capparimya aenigma</i> De Meyer & Freidberg, 2005	7, present study	
4	<i>Ceratitis capitata</i> (Wiedemann, 1824)	1, 4, 5	P
5	<i>Neoceratitis efflatouni</i> (Hendel, 1931)	present study	
6	<i>Neoceratitis flavoscutellata</i> <b>sp. n.</b>	present study	
	Subtribe Dacina		
7	<i>Bactrocera (Zeugodacus) cucurbitae</i> (Coquillett, 1899)	1	P
8	<i>Bactrocera (Daculus) oleae</i> (Gmelin, 1790)	1	P
9	<i>Bactrocera</i> (s. str.) <i>zonata</i> (Saunders, 1842)	6, present study	P
10	<i>Dacus (Leptoxyda) annulatus</i> Becker, 1903	3	M
11	<i>Dacus (Didacus)</i> sp. nr. <i>arcuatus</i> Munro, 1939	present study	
12	<i>Dacus (Didacus) ciliatus</i> Loew, 1862	1, 4	P
13	<i>Dacus (Didacus) frontalis</i> Becker, 1922	1, 5, present study	P
14	<i>Dacus (Leptoxyda) longistylus</i> Wiedemann, 1830	1, present study	B,M
15	<i>Dacus (Leptoxyda) semisphaereus</i> Becker, 1903	present study	
16	<i>Dacus (Didacus) vertebratus</i> Bezzi, 1908	5, present study	P
17	<i>Dacus (Leptoxyda) obesus</i> Munro, 1948	present study	M
18	<i>Dacus</i> sp. 1	present study	
	Subfamily Tephritinae		
	Tribe Noetini		
19	<i>Ensina sonchi</i> (Linnaeus, 1767)	present study	B,M
	Tribe Schistopterini		
20	<i>Bactropota</i> sp. 1	present study	
21	<i>Rhochmopterum arcoides</i> Munro, 1935	present study	
22	<i>Schistopterum moebiusi</i> Becker, 1903	present study	
	Tribe Tephrellini		
	Subtribe Platensina		
23	<i>Psednometopum</i> cf. <i>aldabrense</i> (Lamb, 1914)	present study	
24	<i>Stephanotrypeta brevicosta</i> Hendel, 1931	present study	
25	<i>Stephanotrypeta vittata</i> Freidberg, 1979	3, present study	
	Subtribe Tephrellina		
26	<i>Dicheniotes angulicornis</i> (Hendel, 1931)	present study	
27	<i>Dicheniotes multipunctatus</i> <b>sp. n.</b>	present study	

no	Name	Source	PS
28	<i>Gymnaciura austeni</i> (Munro, 1935)	present study	
29	<i>Metasphenisca hazelae</i> (Munro, 1947)	present study	
30	<i>Metasphenisca negeviana</i> (Freidberg, 1974)	2, present study	
31	<i>Oxyaciura tibialis</i> (Robineau-Desvoidy, 1830)	present study	
32	<i>Paraspheniscoides binarius</i> (Loew, 1861)	present study	
33	<i>Paraspheniscus debskii</i> (Efllatoun, 1924)	present study	
Tribe Tephritini			
34	<i>Acanthiophilus helianthi</i> (Rossi, 1794)	1	P
35	<i>Arabodesis reductiset</i> <b>sp. n.</b>	present study	
36	<i>Campiglossa ignobilis</i> (Loew, 1861)	present study	B
37	<i>Capitites augur</i> (Frauenfeld, 1857)	1*, 3*, present study	
38	<i>Dectodesis auguralis</i> (Bezzi, 1908)	present study	
39	<i>Dectodesis</i> sp. 1	present study	
40	<i>Desmella</i> sp. nr <i>myiopitoides</i> (Bezzi, 1908)	present study	
41	<i>Dioxya sororcula</i> (Wiedemann, 1830)	present study	B, M
42	<i>Euarestella iphionae</i> (Efllatoun, 1924)	2 (from «Arabia»)	
43	<i>Freidbergia mirabilis</i> Merz, 1999	present study	
44	<i>Goniurellia persignata</i> Freidberg, 1980	present study	
45	<i>Goniurellia spinifera</i> Freidberg, 1980	2, present study	
46	<i>Goniurellia tridens</i> (Hendel, 1910)	2	
47	<i>Hyalotephritis complanata</i> (Munro, 1929)	present study	
48	<i>Hyalotephritis planiscutellata</i> (Becker, 1903)	present study	
49	<i>Spathulina acroleuca</i> (Schiner, 1868)	present study	M
50	<i>Sphenella marginata</i> (Fallén, 1814)	present study	B
51	<i>Sphenella setosa</i> <b>sp. n.</b>	present study	
52	<i>Tanaica maculata</i> <b>sp. n.</b>	present study	
53	<i>Tanaica pollinosa</i> <b>sp. n.</b>	present study	
54	<i>Telaletes ochraceus</i> (Loew, 1861)	present study	
55	<i>Tephritomyia despoliata</i> (Hering, 1956)	present study	
56	<i>Trupanea amoena</i> (Frauenfeld, 1857)	1, present study	M
57	<i>Trupanea pseudoamoena</i> Freidberg, 1974	2, present study	
58	<i>Trupanea pulcherrima</i> (Efllatoun, 1924)	2	
59	<i>Trupanea repleta</i> Bezzi, 1918	present study	
60	<i>Trupanea stellata</i> (Fuesslin, 1775)	1	M
61	<i>Trupanea</i> sp. 1	present study	
62	<i>Trupanodesis</i> sp. 1	present study	

The species are arranged according to Norrbom *et al.* (1999a); the nomenclature follows Norrbom *et al.* (1999b), except for the *Tephritis* genus group, where the systematic arrangement of Merz (1999) is adopted.

Morphological terminology is according to White *et al.* (1999), except for the term postpedicel, which is used instead of 1st flagellomere (Stuckenberg, 1999).

Each species is treated in the same way. First, the material studied is recorded. The localities are abbreviated as numbers following the details given in Tab. 3. In the «Distribution» section the general distribution is given. This information is taken basically from Norrbom *et al.* (1999b) and occasionally from other sources. The host plants are listed from the literature given in brackets. It should be noted that other plants may be hosts in Saudi Arabia. The indications about the pest status of each species are mainly taken from White & Elson-Harris (1992). Finally, comments about taxonomy, nomenclature and biology are given in the «Remarks» section.

Tab. 2  
Tephritidae diversity in various countries of the Near and Middle East.

Country	Nr species	Source
Afghanistan	46	Hering (1961)
Egypt	60	Norrbom <i>et al.</i> (1999b)
Iran	23	Hering (1956)
Iraq	31	Korneyev & Diribek (2000)
Israel	85	Freidberg (1988)
Jordan	19	Korneyev & Diribek (2000)
Lebanon	18	Knio <i>et al.</i> (2002)
Saudi Arabia	62	present study
Syria	34	Korneyev & Diribek (2000)
Yemen	51	Merz <i>et al.</i> (in press)

Tab. 3  
Collecting sites in Saudi Arabia, Province of Aseer (= 'Asir).

Nr	Locality	Coordinates	Altitude	coll. Dates	Remarks
1	Abha, Farm Centre (close to locality 2)	18.13N/42.30E	2200	III.-VI.2001	25 km E of Abha
2	Madenate Al-Ameer Sultan	18.13N/42.30E	2200	25.II.-25.V.2002	25 km E of Abha
3	Wadi Hali	18.36N/41.18E	810	9.I.2003	80 km NW Abha
4	Maraba	17.54N/42.23E	260	1.-30.V.2004	60 km S Abha

## RESULTS

### Subfamily TRYPETINAE

#### Tribe CARPOMYINI

##### Subtribe CARPOMYINA

#### *Carpomya incompleta* (Becker, 1903)

*Material.* 2: 11♂♂, 5♀♀.

*Distribution.* Italy, East Africa, Near and Middle East. First recorded from Saudi Arabia by Al-Ahmadi & Salem (1999).

*Host plants.* *Zizyphus* spp. (Rhamnaceae) (Freidberg & Kugler, 1989).

*Pest status.* Pest species in some parts of the world (White & Elson-Harris, 1992).

#### Tribe DACINI

##### Subtribe CERATITIDINA

#### *Capparimyia aenigma* De Meyer & Freidberg, 2005

*Material.* 2: 2♀♀ (identification by M. De Meyer).

*Distribution.* Tropical Africa and Arabian Peninsula. First recorded from Saudi Arabia by De Meyer & Freidberg (2005).

*Host plants.* *Maerua* spp. and *Boscia* spp. (Capparidaceae) (De Meyer & Freidberg, 2005).

*Pest status.* Not a pest species.



*Remarks.* This species was recently described from specimens from Kenya and Tanzania (De Meyer & Freidberg, 2005). The two specimens from Saudi Arabia were also studied but not included into the type series because they differ slightly in thoracic markings from the East African population. The identification is therefore tentative (De Meyer & Freidberg, 2005).

*Neoceratitis efflatouni* (Hendel, 1931)

*Material.* 2: 1 ♂.

*Distribution.* Originally described from Sudan, subsequently found in Egypt and Israel. New for Saudi Arabia.

*Host plant.* *Lycium schweinfurthii* (Solanaceae) (Freidberg & Kugler, 1989).

*Pest status.* Not a pest species.

*Neoceratitis flavoscutellata* sp. n.

Figs 1-10

*Material.* Holotype ♂: SAUDI ARABIA: Abha, Madenate Ameer Sultan, 22.II.-25.V.2002, H. A. Dawah (MHNG). Paratypes: 16 ♂♂, 20 ♀♀, same data as holotype (CHD, KMMA, MHNG, NMWC, TAU). The holotype is double-mounted on a minuten pin on a polyporus block and is in good condition with only the left midleg missing.

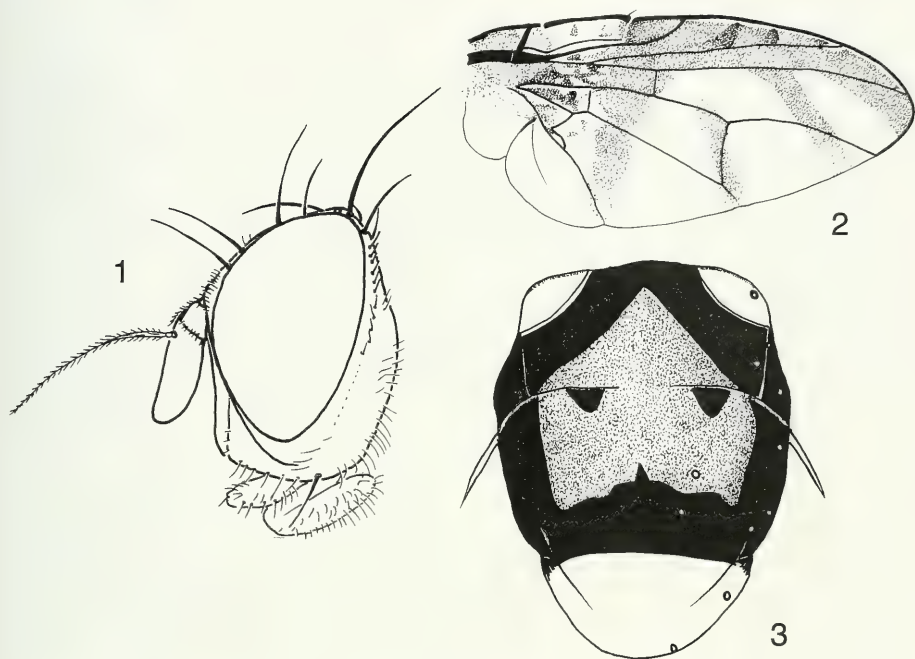
*Etymology.* The species is named after the entirely yellow scutellum, which is a unique characteristic within the genus.

*Diagnosis.* This is the only species of *Neoceratitis* with an entirely yellow scutellum dorsally (Fig. 3); wing with discal, anterior and posterior apical band fused in r1 and r2+3, subapical band isolated (Fig. 2).

*Description.* WING LENGTH. Male: 3.3-4.1 mm; female: 3.65-4.35 mm.

**HEAD** (Fig. 1). Anterior half of frons, ventral three quarters of face, and most of gena whitish-yellow; posterior half of frons and dorsum of occiput brownish-yellow; ocellar triangle, dorsal quarter of face and irregular pattern on occiput dorsal to occipital foramen blackish; gena with indistinct brown to black spot at eye margin; antenna and mouthparts yellow, but postpedicel with faint black tinge. Head in profile almost 1.5 times as high as long; gena about 1/6 to 1/5 as high as compound eye, the latter elongate oval; frons slightly longer than wide, in dorsal view slightly more than half as wide as entire head width; frons black setulose in middle; face not projecting at vibrissal corner, with indistinct antennal grooves separated by a broad, evenly convex carina; palpus slightly flattened, with black, stiff setulae; proboscis rather fleshy, capitate; antenna little shorter than face, postpedicel about twice as long as wide, apico-dorsally indistinctly pointed; arista setulose with longest rays about as long as basal diameter of arista. Chaetotaxy as in other *Neoceratitis*, all setae black: 2 frontal, 2 orbital (posterior about 0.75 times as long as anterior), 1 strong ocellar, 1 postocellar, 1 medial vertical, 1 lateral vertical, 1 genal, 1 row of postocular setae.

**THORAX.** Mesonotum dorsally with a pattern as in Fig. 3; postpronotum entirely whitish-yellow; a narrow yellow stripe from wing base along transverse suture; dorsal surface medially grey microtrichose, laterally with a shining, black, broad border; grey pattern anteromedially pointed and posteriorly with 1-3 black teeth penetrating into grey area; a pair of shiny black spots just posterior of transverse suture; scutellum swollen, whitish-yellow with a narrow brown to black spot laterally at base, white



FIGS 1-3

*Neoceratitis flavoscutellata* sp. n. (paratype from Abha): 1, head, lateral view; 2, wing; 3, thorax, dorsal view.

setulose on dorsal surface; most of anepisternum, anatergite and katatergite whitish-yellow, remaining parts of pleuron brown to black, subshining; setulae on grey and whitish-yellow surfaces white, other setulae pale brown; prosternum with pale brown setulae. Chaetotaxy as in other *Neoceratitis*, all setae black: 2 scapular, 1 postpronotal, 2 notopleural, 1 presutural supra-alar, 1 postsutural supra-alar, 1 intra-alar, 1 postalar, 1 dorsocentral posterior to line of postsutural supra-alar, 1 acrostichal, 1 anepisternal, 1 anepimeral, 1 katepisternal, 2 (pairs of) scutellar setae.

**LEGS.** All femora (except for knees) brown, distal parts contrastingly yellow; mid- and hindfemur anteroventrally with 4-7, midfemur dorsoventrally with 4-5 short, black setulae at apex; midtibia with a black apicoventral seta.

**WING** (Fig. 2). R1 dorsally entirely setulose, ventrally with 4-6 setulae in distal half of pterostigma; node of R2+3 and R4+5 ventrally with 2-3 setulae; R4+5 dorsally setulose over level of DM-Cu, the latter oblique; distance between R-M and DM-Cu on M about 1.2 times the length of DM-Cu; cell bcu with conspicuous posterodistal lobe; anal lobe large, undulating; wing with brown to black pattern, without light yellow areas; arrangement of spots and bands as in Fig. 2: Base of wing largely brown, in particular bc and surface ventral to stem vein; numerous brown streaks and spots from c to bcu; distally with 4 crossbands, the discal, anterior and posterior apical bands fused in r1 and r2+3; the subapical band well isolated from remaining pattern, obliquely transversing DM-Cu; r1 with 2-3 darker teeth-like spots; wing along C very

narrowly hyaline. Halter and calypteres whitish-yellow; both calypteres convex, subequal.

**ABDOMEN MALE.** Bicoloured, with posterior margin of tergite 1, lateral spots on tergite 2, entire tergite 3 and anterior third of tergite 4 dark brown, other parts of tergites 1-4 whitish-yellow; tergite 5 yellow medially, becoming gradually darker brown laterally; tergites black setulose, except for whitish-yellow parts on tergites 1-4, which are white setulose. Terminalia (Figs 4-6): epandrium ovoid, fused with lateral surstyli, the latter bifurcated and black distally, with a slightly pointed, apically directed, sparsely setulose branch and a broad ventral plate; medial surstylus narrow, with two black, subequal prensisetae; cercus large, setulose; hypandrium and associated structures symmetrical, glans as in Fig. 6 (drawn from compressed glans), of complicated 3-dimensional structure; vesica spoon-shaped, very large, bordered by a broad fringe of minute tubercles; its articulation with remaining glans flexible; subapical lobe well developed, with a sclerotized tip and a bar-like sclerotization basally; acrophallus composed of two ducts, the more straight one weakly sclerotized, subapically surrounded by a strongly sclerotized sheath.

**ABDOMEN FEMALE.** As in male, but entire anterior third of tergite 2 brown; tergite 6 almost invisible in dorsal view, at most 1/6 as wide as tergite 5; oviscape (Fig. 7) swollen, shining orange brown, but tip dark brown, black setulose; as long as 2-3 preceding tergites combined; aculeus (Figs 8-9) evenly pointed; sternite 8 width / aculeus length ratio = 0.8; aculeus length: 1.2 mm; 2 spermathecae present (Fig. 10): composed of a spherical apical part with a reticulate surface and a cylindrical base with some rather sharp projections.

*Distribution.* Saudi Arabia.

*Host plants.* Unknown. All specimens were collected in a Malaise trap.

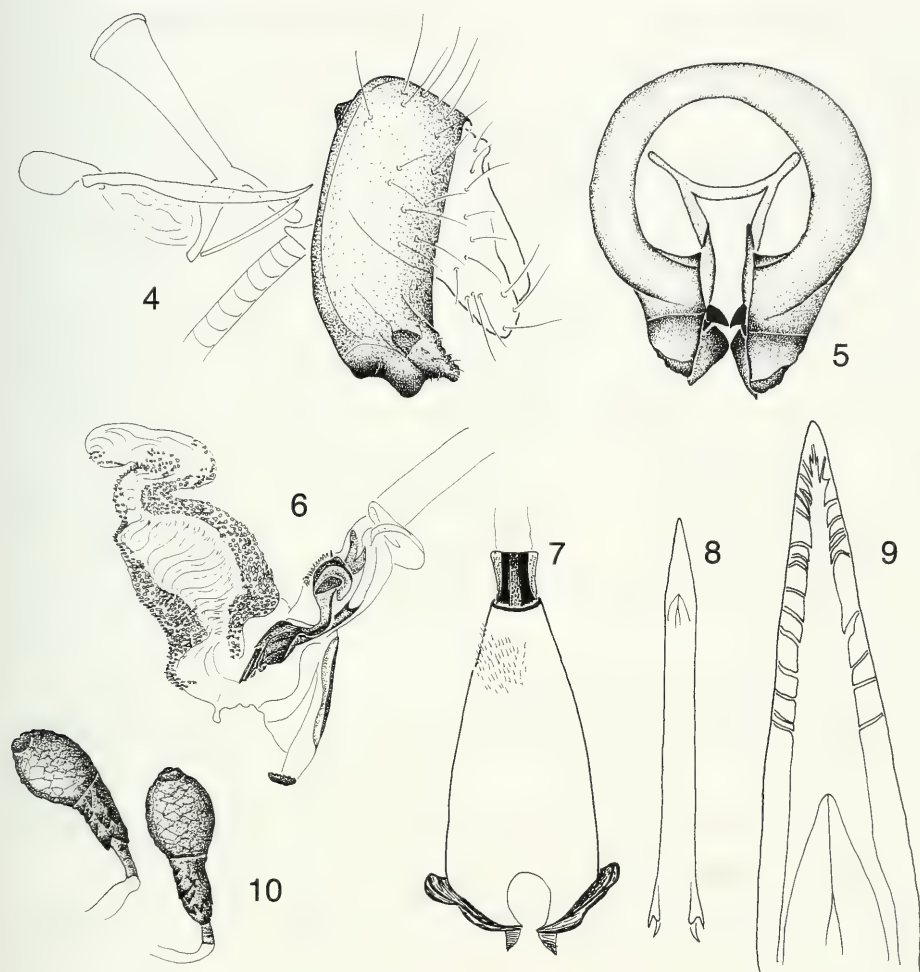
*Pest status.* Not a pest species.

*Remarks.* The genus was diagnosed under the name *Trirhithromyia* Hendel, 1931, by Hardy (1967) and Freidberg & Kugler (1989). Korneyev (1994) synonymized *Trirhithromyia* with *Neoceratitis* Hendel, 1927, and redescribed the genus. The new species fits well the characteristics given in these papers. The colour of the scutellum, however, which has black spots on the dorsal surface in other species of the genus, was considered to be of generic value by Hardy (1967) and Korneyev (1994), but *N. flavoscutellata* has only a narrow brown spot ventrobasally. Shape of head, wing pattern and genitalic characters show, however, that this species is congeneric with other *Neoceratitis*.

Within *Neoceratitis*, the new species appears to be related to *N. cyanesces* (Bezzi, 1923) which is known from Madagascar, Mauritius and La Réunion, sharing the same wing pattern and the entirely yellow postpronotal lobes. The grey-microtrichose pattern on the mesonotum and the colour of the abdomen are very different in the two species, in addition to the coloration of the scutellum (3 couples from La Réunion, St. Pierre (MHNG) studied, see Fig. 6 in Hancock, 1984).

Male terminalia of the new species differ clearly from those of *N. efflatouni* in length of vesica and sclerotization of glans (see Freidberg & Kugler, 1989, Fig. 216). On the other hand, they are similar to *Ceratitis capitata* (Wiedemann, 1824), as illustrated by Freidberg & Kugler (1989, Fig. 193). Unfortunately, male terminalia are unknown for most species of the Ceratitidina, thus, their value for phylogeny or species recognition is limited.





FIGS 4-10

*Neoceratitis flavoscutellata* sp. n. (4-6, male; 7-10, female, paratypes from Abha): 4, epandrium, lateral view; 5, same, caudal view; 6, glans; 7, oviscape; 8, aculeus; 9, tip of aculeus; 10, spermathecae.

#### Subtribe DACINA

#### *Bactrocera* (s. str.) *zonata* (Saunders, 1842)

**Material.** 4: 1♂ (identification by I. M. White); 1♀, same, but IX.-X.2004 (identification by J. C. Deeming) (NMWC).

**Distribution.** Originally an Oriental species which was introduced to various countries of the Near East (Egypt, Israel, United Arab Emirates, Oman, Iran, Yemen) and some islands in the Indian Ocean (Réunion, Mauritius). Recorded from Saudi Arabia anonymously (Anonymus, 2002).

**Host plants.** Reared from numerous plants belonging to different families (White & Elson-Harris, 1992).



*Pest status.* Pest species in some parts of the world (White & Elson-Harris, 1992).

***Dacus (Didacus) sp. nr. arcuatus* Munro, 1939**

*Material.* 2: 2♂♂ (identifications by I. M. White).

*Distribution.* Published records of *D. arcuatus* from Kenya and South Africa. New for the Arabian Peninsula.

*Host plant.* *D. arcuatus* was reared from *Pergularia* sp. (Asclepiadaceae) (Munro, 1984).

*Remarks.* According to White (pers. comm.) the two males fit rather well *D. arcuatus*, but differ in morphological details. At the present moment only these two males are available from the Arabian Peninsula, and a safe identification is not possible.

***Dacus (Didacus) frontalis* Becker, 1922**

*Material.* 2: 3♂♂, 1♀; 4: 1♀ (identifications by I. M. White).

*Distribution.* Entire Afrotropical Region including the Arabian Peninsula. Recorded from Saudi Arabia by White & Elson-Harris (1992) and Al-Ahmadi & Salem (1999).

*Host plants.* Various Cucurbitaceae (White & Elson-Harris, 1992).

*Pest status.* Pest species in some parts of the world (White & Elson-Harris, 1992).

***Dacus (Didacus) vertebratus* Bezzi, 1908**

*Material.* 2: 1♂; 4: 3♂♂, 2♀♀ (identifications by I. M. White) (MHNG, NMWC).

*Distribution.* Entire Afrotropical Region including Madagascar, and the Arabian Peninsula. Recorded from Saudi Arabia by Munro (1984) and White & Elson-Harris (1992).

*Host plants.* Various Cucurbitaceae (White & Elson-Harris, 1992).

*Pest status.* Pest species in some parts of the world (White & Elson-Harris, 1992).

***Dacus (Leptoxyda) longistylus* Wiedemann, 1830**

*Material.* 4: 1♀ (identification by I. M. White).

*Distribution.* Afrotropical Region, Arabian Peninsula (Munro, 1984). Reported from Saudi Arabia by Al-Ahmadi & Salem (1999) and Carroll *et al.* (2002).

*Host plant.* Reared from Sodom apple (*Calotropis procera*, Asclepiadaceae) (Munro, 1984).

*Pest status.* A potential pest species in areas where the host is cultivated. On the other hand, Sodom apple is poisonous to livestock, and *D. longistylus* may therefore be useful for Biological Control in other parts of its distribution range (White & Elson-Harris, 1992).

***Dacus (Leptoxyda) obesus* Munro, 1948**

*Material.* 4: 1♂ (identification by I. M. White).

*Distribution.* So far only known from Kenya. New for Saudi Arabia.

*Host plant.* Reared from Sodom apple (*Calotropis procera*, Asclepiadaceae) (Munro, 1984).

*Pest status.* A potential pest species in areas where the host is cultivated (White & Elson-Harris, 1992).

*Remarks.* This is one of the most remarkable species of *Dacus*, characterized by a number of unusual features. Males lack a pecten on tergite 3; other characters of this small species are the blue-grey, silvery microtrichose scutum, the compact body, the broad continuous black band along anterior wing margin which is covering both costal cells, the absence of an anal streak, the presence of 2 black spots on the face, the absence of both supra-alar and prescutellar setae, the entirely yellow scutellum, the absence of stripe-like medial and lateral postsutural vittae (but with a yellow transversal marking in posterior half of scutum), the presence of two postalar vittae across katatergite and anatergite, and the entirely yellow legs. A comprehensive description and useful illustrations were provided by Munro (1984, p. 151). Because of the unusual set of characters Munro (1984) erected the new tribe *Pionodacini* and the new genus *Pionodacus* Munro, 1984, for this species. This proposal, however, was not accepted by subsequent workers (Norrbom *et al.*, 1999a).

***Dacus (Leptoxyda) semisphaereus* Becker, 1903**

*Material.* 4: 1 ♀ (identification by I. M. White) (NMWC).

*Distribution.* Eastern Africa from Egypt to Sudan and Ethiopia. New for Saudi Arabia.

*Host plant.* Unknown.

*Pest status.* Not a pest species.

*Remarks.* The data concerning this species were communicated by J. C. Deeming (in litt., 8.I.2005).

***Dacus (Leptoxyda)* sp. 1**

*Material.* 4: 1 ♂, 1 ♀ (identifications by I. M. White).

*Remarks.* This species is externally similar to *D. obesus*, differing chiefly in the colour of the scutum, which is black posterior of the suture (with a transversal yellow marking on posterior half of scutum in *D. obesus*). Currently, a revision of the genus is in preparation by I. M. White and the species will be formally described in this work.

**Subfamily TEPHRITINAE**

**Tribe NOEETINI**

***Ensina sonchi* (Linnaeus, 1767)**

*Material.* 2: 1 ♂, 2 ♀ ♀.

*Distribution.* Large distribution in Palaearctic, Afrotropical, Australasian (Hawaii) and Oriental Regions. New for Saudi Arabia.

*Host plants.* Wide range of Asteraceae of the subfamily Cichorioideae (*Chondrilla*, *Crepis*, *Helminthia*, *Lactuca*, *Picris*, *Scorzonera*, *Sonchus* and others) (Freidberg & Kugler, 1989; Hendel, 1927; Merz, 1994).

*Pest status.* A potential or minor pest on some cultivated plants (*Scorzonera* in Ukraine). On the other hand *E. sonchi* may be important in the natural regulation of *Sonchus oleraceus*, which is a weed in some parts of the world (White & Elson-Harris, 1992).

## Tribe SCHISTOPTERINI

*Bactropota* sp. 1

*Material.* 3: 45 specimens.

*Remarks.* This species differs readily from *B. woodi* Bezzi, the only described species of the genus (Freidberg, 2002), in wing pattern. In contrast to *B. woodi* the anterior margin has ill-defined, small yellow-brown areas, thus the entire wing appears much darker without two hyaline incisions which are present in *B. woodi* (see Fig. 2A in Freidberg, 2002). A revision of the genus is currently prepared by Freidberg *et al.* and the species will be formally described in that study.

*Rhochmopterum arcoides* Munro, 1935

*Material.* 2: 1 ♂.

*Distribution.* East Africa. New for Saudi Arabia.

*Host plant.* Reared in South Africa from flower heads of *Vernonia kraussii* (Asteraceae) (Munro, 1935).

*Pest status.* Not a pest species.

*Remarks.* This genus is in bad need of revision. At least 10 undescribed species are known in addition to the 6 described species from the Afrotropical Region (Freidberg, 2002). The specimen at hand fits very well the description and illustration of Munro (1935) as well as one couple from Kenya (Magadi road, 3.III.1993, leg. B. Merz, MHNG). The only difference concerns the colour of the tibiae, which are yellow with two black rings in basal and distal third in the specimens studied from Saudi Arabia and Kenya, whereas Munro (1935) did not give any indication of their colour.

*Schistopterum moebiusi* Becker, 1903

*Material.* 2: 1 ♂, 4 ♀ ♀; 3: 1 ♂, 1 ♀.

*Distribution.* Eastern Africa north to Lebanon (Deeming, in litt.), Yemen (Merz *et al.*, in press). New for Saudi Arabia.

*Host plant.* *Pluchea dioscoridis* (Asteraceae) (Freidberg & Kugler, 1989).

*Pest status.* Not a pest species.

## Tribe TEPHRELLINI

## Subtribe PLATENSININA

*Psednometopum* cf. *aldabrense* (Lamb, 1914)

*Material.* 2: 2 ♂ ♂.

*Distribution.* This species is only known from the island of Aldabra (Seychelles). The record from Kenya (Merz *et al.*, in press) is based on a misidentification of *P. nigrum* Munro, 1937. New for Saudi Arabia.

*Host plants.* Unknown.

*Pest status.* Not a pest species.

*Remarks.* *P. aldabrense* was recently recorded from Yemen based on one male (Merz *et al.*, in press), and this specimen belongs to the same species as the two males from Saudi Arabia. D. L. Hancock studied recently the types and additional specimens of *Tephritis aldabrensis* Lamb from Aldabra (in NHML) and found that the specimens

from the Arabian Peninsula differ from those of Aldabra by the entirely black pterostigma (with hyaline spot in specimens from Aldabra), and he concluded that they may belong to an undescribed species (Hancock, in litt.). However, as a very limited number of specimens is available and the two populations differ only slightly, the intraspecific variability of the species in the genus is poorly known. We prefer therefore not to describe a new species.

***Stephanotrypeta brevicosta* Hendel, 1931**

*Material.* 2: 2♂♂.

*Distribution.* Kenya, Sudan. New for Saudi Arabia.

*Host plants.* Unknown.

*Pest status.* Not a pest species.

***Stephanotrypeta vittata* Freidberg, 1979**

*Material.* 2: 1♂, 3♀♀.

*Distribution.* East Africa, Madagascar, Arabian Peninsula. Recorded from Saudi Arabia by Freidberg (1979).

*Host plant.* Unknown.

*Pest status.* Not a pest species.

*Remarks.* We follow here Freidberg (1979) for the generic placement of the species and do not accept the proposition of Hancock (2003), who transferred this species to *Terpnodesma* Munro.

Subtribe TEPHRELLINA

***Dicheniotes angulicornis* (Hendel, 1931)**

*Material.* 2: 1♂.

*Distribution.* Described from Sudan, later found in Yemen (Merz *et al.*, in press). New for Saudi Arabia.

*Host plants.* Unknown.

*Pest status.* Not a pest species.

***Dicheniotes multipunctatus* sp. n.**

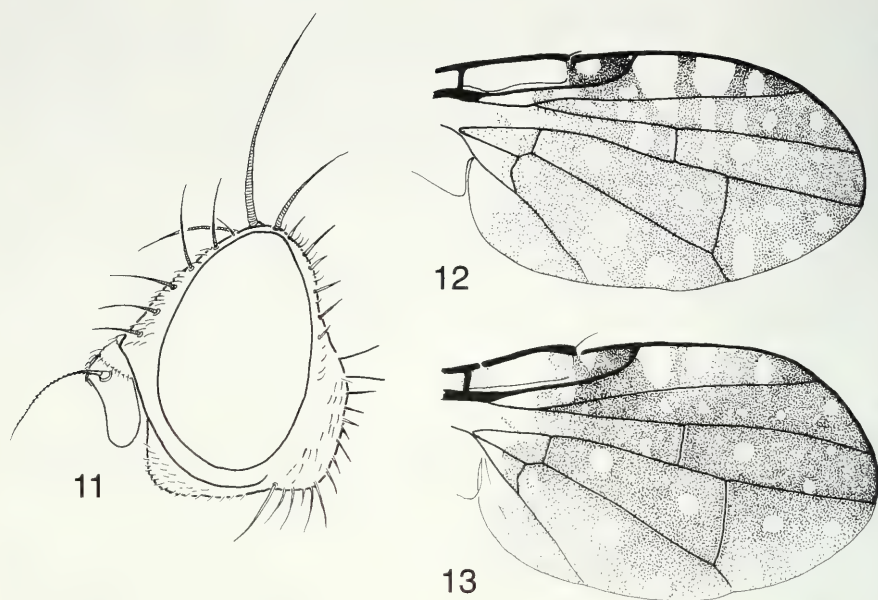
Figs 11-13

*Dicheniotes* sp. - Merz *et al.* (in press).

*Material.* Holotype ♂: KENYA: Rt. B4 nr. Lake Baringo, 28.XI.1986, A. Freidberg (TAU). Paratypes: KENYA: 1♂, Voi, Rt. A109, 4.6.V.1991, A. Freidberg & F. Kaplan (MHNG); 1♀, (N. W.) Kainuk, on Morun River, 25.XI.1989, A. Freidberg & F. Kaplan (TAU). SAUDI ARABIA: 1♀, Abha, Madenat Ameer Sultan, 22.II.-25.V.2002, H. A. Dawah (MHNG). TANZANIA: 1♀, Same, Rt. B1, 8-16.IX.1992, A. Freidberg (TAU); 1♂, 1♀, Dar es Salam, 20 km N, Rt. B1212, 4.IX.1996, A. Freidberg (TAU). YEMEN: 1♀, ar-Rujum, 16.X.2000-15.I.2001, Malaise trap, A. van Harten & A.M. Hager (MHNG); 1♀, Lahj, VIII.2000, Malaise trap, A. van Harten & A. Sallam (ZMUA); 1♀, 12 km NW of Manakhah, 27.III-5.V.2002, Mal. trap, A. van Harten; 1♀, same, but 5.V-17.VI.2002 (MHNG). The holotype is double-mounted on a minuten pin on a polyporus block and is in excellent condition.

*Etymology.* The species is named after the wing pattern with numerous hyaline and subhyaline spots.





FIGS 11-13

*Dicheniotes multipunctatus* sp. n.: 11, head, lateral view (holotype); 12, wing of male (holotype); 13, wing of female (paratype from Yemen, slightly modified after Merz *et al.*, in press).

**Diagnosis.** This species belongs to the group of species of *Dicheniotes* with a hyaline spot in cell r2+3 at the tip of R2+3 (Figs 12-13) and normal head shape without oblique oral opening or large labella (Fig. 11). It differs from all other species of the genus by the presence of 3 hyaline spots in cell r1, which are either small, or elongated and extending into cell r2+3; remainder of wing with numerous hyaline or subhyaline spots; sexual dimorphism of wing pattern present, but weak. Scutum thickly grey microtrichose, with distinct, coarse white setulae. Abdomen reddish-brown, subshining.

**Description.** WING LENGTH. Male: 3.15-3.35 mm; female: 2.70-3.35 mm.

**HEAD** (Fig. 11). Predominantly yellow, but ocellar triangle and a paired spot on occiput dorsal to occipital foramen greyish black; posterior half of frons, frontal and orbital plates silvery; face indistinctly whitish yellow; palpus and antenna entirely yellow, only apical two third of arista brown; head in profile about 1.2 times as high as long; gena narrow, about one tenth as wide as compound eye; at anterior margin with 2-3 rows of brown, rather short subvibrissal setulae of equal length; frons slightly wider than long (measured from posterior margin of posterior ocelli to base of antenna), tapering anteriorly; covered with numerous white setulae anteriorly; face shallow concave, without carina, vibrissal corner produced anteriorly to about same level as frontofacial corner; scape and pedicel black setulose; postpedicel 1.5 times as long as wide, dorsally slightly concave, rounded dorsoapically; arista almost bare, rays at most as long as basal diameter of arista; palpus short, not projecting beyond vibrissal

corner. The following paired pale brown setae are present: 1 genal, 3 frontal, 2 orbital, 1 ocellar, 1 medial vertical seta; 2 lateral vertical setae pale brown to white depending on illumination; postocellar and paraverticlar setae white; postocular setae mixed with long, white and short, black setulae.

**THORAX.** Scutum, dorsal surface of scutellum and pleura posterior to anterior spiracle black, very densely grey microtrichose, mat, black ground colour entirely invisible; postpronotum, posterior two third of notopleuron, pleura anterior to anterior spiracle and on ventral side of scutellum mat yellow to pale brown. Mesonotum covered with numerous short, white, coarse setulae; prosternum white setulose. The following pale brown, paired setae are present: 1 dorsocentral inserted closer to level of anterior supra-alar seta than to suture, 1 prescutellar acrostichal, 1 presutural supra-alar, 1 postsutural supra-alar, 1 intra-alar, 1 postalar, 1 postpronotal, 2 notopleural and 2 (pairs of) subequal scutellar setae; 2 anepisternal, 1 katepisternal and 1 anepimeral seta.

**LEGS.** Entirely yellow; hindtibia anterodorsally with a row of 4-7 outstanding setulae.

**WING MALE** (Fig. 12). Very wide, about 1.8 times as long as wide, apically broadly rounded, posteriorly with large anal lobe; R1 dorsally setulose except for a gap opposite subcostal break; R4+5 ventrally with 1-6 setulae proximally R-M, dorsally with 3-5 black setulae to level of R-M. Pattern orange brown, covering most of surface distal to subcostal break and interrupted by about 20 hyaline and 10 slightly yellowish spots; cell c hyaline with narrow brown stripes at base and tip; pterostigma with hyaline spot; r1 with 3 hyaline spots with the basal two spots larger, extending into cell r2+3; r2+3 with 6-8 small hyaline or pale yellowish spots; br with 1-2 hyaline spots; r4+5 with 4-5 spots, apex largely black; dm with 2-3 hyaline spots; m with 4 spots which are separated from each other by distance greater than their diameter; cu2 and anal lobe with about 4 spots. Halter and calypteres yellow. Lower, ventral calypter smaller than upper, dorsal.

**WING FEMALE** (Fig. 13). Shape and chaetotaxy as male; pattern darker brown, with hyaline spots clearly separated from dark area and only few yellowish spots present; only basal hyaline spot of r1 occasionally penetrating into r2+3, second hyaline spot of r1 always isolated from hyaline spot in r2+3. The female from Kainuk (Kenya), the smallest specimen (wing length: 2.70 mm; all other specimens > 3.0 mm) has only 2 hyaline spots in r2+3, remaining pattern as in other specimens.

**ABDOMEN MALE.** Strongly reddish-brown, subshining; basal two tergites mainly white setulose, other tergites covered with short black setulae. Epandrium reddish; structure not studied.

**ABDOMEN FEMALE.** Preabdomen as male; oviscapae black, shining, pale brown setulose, about as long as length of 2.5 preceding tergites combined; eversible membrane with numerous denticles; aculeus evenly narrowed, apically sharply pointed.

**Distribution.** Eastern Afrotropical Region (Kenya, Tanzania) and Arabian Peninsula (Saudi Arabia, Yemen).

**Host plants.** Unknown. The specimens from the Arabian Peninsula were collected in Malaise traps.

**Pest status.** Not a pest species.

*Remarks.* The generic position of this species may be subject to discussions. In the key of Munro (1947) it runs with some problems to *Platensina* Enderlein because of the rather thick, ash-grey microtrichose mesonotum and the chaetotaxy (couplet 21 in Munro, 1947). However, some species of *Dicheniotes* Munro, such as *D. polyspila* (Bezzi), have also an ash-grey microtrichose mesonotum and a very similar type of wing pattern and head shape (some 30 specimens of both sexes from Kenya, along road from Nairobi to Mombasa between Hunters Lodge and Mtito Andei studied, MHNG). Its inclusion in *Dicheniotes* (3 frontal setae, 2 orbital setae, 2 pairs of scutellar setae, postocular setae mixed white and black, wing of *Tephrella* type of Munro, 1947) seems therefore justified.

Within *Dicheniotes* the new species differs from all congeners in wing pattern with 3 hyaline spots in cell r1, of which the apical spot is smaller than the two basal spots, but still clearly present, and the more numerous hyaline spots on the remaining wing surface. Because of the presence of a hyaline spot in r2+3 below tip of R2+3 *D. multipunctatus* runs to couplet 9 in Munro (1947, p. 178) next to *D. polyspila* which is morphologically similar with the same reddish abdomen and the thick, ash-grey microtrichose mesonotum and thus differing from the much more subshining mesonotum and shining black abdomen of other species, such as *D. angulicornis*, *D. erosa* (Bezzi) or *D. katonae* (Bezzi). The new species differs from *D. polyspila* by the following set of characters in addition to those given above: wing with less conspicuous dimorphism (very prominent in *D. polyspila*: male with basal half of r1 and r2+3, and cell br entirely hyaline, and r2+3 at tip with two broadly confluent hyaline spots; female with more isolated spots), hyaline spots often not sharply separated from black area (usually very sharply separated in *D. polyspila*), and oviscape much shorter than preabdomen (in *D. polyspila* about as long as preabdomen).

***Gymnaciura austeni* (Munro, 1935)**

*Material.* 2: 1 ♀.

*Distribution.* Entire Afrotropical Region, Yemen (Merz *et al.*, in press). New for Saudi Arabia.

*Host plants.* Unknown.

*Pest status.* Not a pest species.

***Metasphenisca hazelae* (Munro, 1947)**

*Material.* 2: 1 ♂, 3 ♀♀.

*Distribution.* Eastern Africa. New for Saudi Arabia.

*Host plant.* *Barleria rehmanni* (Acanthaceae) (Munro, 1947).

*Pest status.* Not a pest species.

*Remarks.* Hancock (in litt.) found another specimen from Saudi Arabia in the unsorted material of the NHML: 1 ♂, Dhamar, 3.IX.62 (or 42), G. Popov (NHML).

***Metasphenisca negeviana* (Freidberg, 1974)**

*Material.* 2: 1 ♂.

*Distribution.* Near East. Recorded from Saudi Arabia by Freidberg & Kugler (1989).

*Host plant.* *Blepharis attenuata* (Acanthaceae) (Freidberg & Kugler, 1989).

*Pest status.* Not a pest species.

***Oxyaciura tibialis* (Robineau-Desvoidy, 1830)**

*Material.* 2: 2 ♀ ♀.

*Distribution.* Western Palaearctic Region to Afghanistan, Ethiopia. New for Saudi Arabia.

*Host plants.* *Lavandula* spp., *Nepeta septemcrenata* (Lamiaceae) (Freidberg & Kugler, 1989; Hendel, 1927; Merz, 1992).

*Pest status.* Not a pest species.

***Paraspheniscoides binarius* (Loew, 1861)**

*Material.* 2: 1 ♀.

*Distribution.* Afrotropical Region and islands of the Indian Ocean, Yemen (Merz *et al.*, in press). New for Saudi Arabia.

*Host plants.* *Lippia* spp. and *Lantana* spp. (Verbenaceae) (Munro, 1947).

*Pest status.* Not a pest species.

***Paraspheniscus debskii* (Eflatoun, 1924)**

*Material.* 2: 1 ♀.

*Distribution.* Described from Egypt. New for Saudi Arabia.

*Host plant.* *Stachys aegyptiaca* (Lamiaceae) (Eflatoun, 1924; Freidberg & Kugler, 1989; Hendel, 1927).

*Pest status.* Not a pest species.

Tribe TEPHRITINI

***Campiglossa* genus group**

***Campiglossa ignobilis* (Loew, 1861)**

*Material.* 2: 34 ♂ ♂, 41 ♀ ♀, 1 without abdomen.

*Distribution.* Eastern Afrotropical Region, Yemen. New for Saudia Arabia.

*Host plant.* *Sonchus oleraceus* (Asteraceae) (Munro, 1957a).

*Pest status.* Because its host is a weed in some parts of the world, this species may be useful in the natural regulation of *S. oleraceus*.

***Desmella* sp. nr *myiopotoides* (Bezzi, 1908)**

*Material.* 2: 2 ♀ ♀.

*Distribution.* *D. myiopotoides* is known from the Eastern Afrotropical Region. Recently, a specimen of the *D. myiopotoides*-group was also found in Oman (Jebel Shams, 2500m, 7.V.1989, leg. M. J. Ebejer, MHNG, new record). New for Saudi Arabia.

*Host plant.* *D. myiopotoides* was reared in South Africa from flowers of *Chrysocoma tenuifolia* (Asteraceae) (Munro, 1925).

*Pest status.* Not a pest species.

*Remarks.* As Munro (1957a) pointed out this genus is in bad need of a revision. No further progress has been carried out since then. The two females at hand key out as *D. myiopotoides* (Bezzi), but this may be a complex of different species (Munro,



1957a). One female has a wing pattern similar to Fig. 137, and the other is similar to Fig. 139 in Munro (1957a). No males are available which may have good characters (Munro, 1957a). For these reasons the specimens from Saudi Arabia cannot be identified unambiguously. The genus is newly recorded for Saudi Arabia.

***Dioxya sororcula* (Wiedemann, 1830)**

*Material.* 2: 5 ♀ ♀.

*Distribution.* Tropics and Subtropics of the Old World, Australia, introduced to Hawaii. New for Saudi Arabia.

*Host plants.* *Bidens* spp., *Guizotia* sp., *Lactuca sativa* (Asteraceae) (Freidberg & Kugler, 1989; Merz, 1992; White & Elson-Harris, 1992).

*Pest status.* A potential or minor pest on some cultivated plants (*Lactuca* in the Philippines). On the other hand it may be important in the natural regulation of *Bidens* spp. which are weeds in some parts of the world (White & Elson-Harris, 1992).

***Tanaica* Munro, 1957**

Type species: *Ensina hyalipennis* Bezzi, 1924

*Diagnosis.* Within the *Campiglossa* group of genera *Tanaica* (Munro, 1957a) may be recognized by the flattened head (Fig. 24) which is longer than high in profile and the narrow gena; by the long labella which are longer than height of head and which are projecting distinctly beyond anterior vibrissal corner; by the wing, which is either entirely hyaline or which has a faint reticulate pattern (Figs 15, 25); by the legs, with the femora black except for the apical quarter; and by the male terminalia: preglans with two setulose areas and glans with two sclerotized plates of uneven length emerging from acrophallus, with the longer plate strongly concave (Figs 29-30).

*Redescription.* HEAD (Figs 14, 24). In profile flattened, longer than high; gena narrow, less than 0.8 times as wide as width of postpedicel; height of gena less than 0.15 times the height of compound eye; frons bare; frontal stripe (as defined by Munro, 1957a) indistinct, almost invisible; face concave; vibrissal corner distinctly projecting beyond frontofacial corner; mouthparts strongly geniculate with labella longer than height of head and projecting beyond vibrissal corner; palpus thin, parallel-sided, as long as labella; scape and pedicel black setulose; postpedicel about 1.5 times as long as wide, dorsoapically rounded; arista almost bare. Chaetotaxy: 2 black frontal setae; 2 orbital setae, anterior black, posterior short, white; ocellar seta black; medial vertical seta black; lateral vertical seta and postocellar seta white; paraverticlar seta absent or short and white; medial postocellar seta absent; postocular setae mixed white and black.

THORAX. Scutum white setulose, more or less uniformly grey microtrichose, without distinct brown longitudinal stripes; scutellum apically with small yellow patch. Chaetotaxy (all setae black): 1 postpronotal seta; 2 notopleural setae, the posterior shorter; 1 presutural supra-alar seta; 1 postsutural supra-alar seta; 1 intra-alar seta; 1 postalar seta; 1 dorsocentral seta distinctly anterior to level of postsutural supra-alar seta; 1 acrostichal seta; 2 (pairs of) scutellar setae, the apical less than half as long as the basal; 1 anepisternal seta and 1 kataposternal seta, both black; 1 white, lanceolate anepimeral seta.

LEGS. Mat yellow, but basal 0.7-0.8 of all femora black; coxae and trochanters black or mixed black and yellow; midtibia with 1 apicoventral black seta.

WING (Figs 15, 25). Hyaline or with faint reticulate pattern; pterostigma hyaline or brown with round hyaline spot medially; posterodistal extension of cell bcu short, but distinct; R-M in distal third of cell dm; distance between crossveins equal to length of DM-Cu; veins bare, only R1 with usual dorsal row of setulae, which is interrupted opposite level of tip of Sc, and ventrally with 0-5 setulae in distal half of pterostigma. Calypteres yellow, lower, ventral calypter strip-like, much smaller than upper, dorsal; halter yellow.

ABDOMEN MALE. Shining black or grey microtrichose and then with indistinct black paired spots on tergites; sternite 5 (Figs 16, 26) smoothly concave apically; epanthrium (Fig. 18) ovoid, with distinct epanthrial process; medial surstylus with 2 prenisetae of very unequal length, medial preniseta much larger (Fig. 19); preglans area with two areas of fine setulae (Fig. 20); glans with strongly sclerotized, tube-like acrophallus; vesica twice as long, with two sclerotized plates, the longer twice as long as the shorter, concave; shorter plate distally truncate.

ABDOMEN FEMALE. Preabdomen as male; ov scape black, fine black setulose; at most as long as preceding 3 tergites combined; aculeus (Figs 21-22) evenly pointed apically; two spherical, pyriform spermathecae with small papillae (Fig. 23).

*Remarks.* *Tanaica* was described by Munro (1957a) in the *Ensina* series of genera for a species with entirely hyaline wings and a shining black abdomen. As it was already admitted by Munro (1957a), the genera placed in this group do not belong to a homogenous group, but are merely an assemblage of taxa which cannot be placed elsewhere. In fact, *Ensina* Robineau-Desvoidy is now placed in the tribe Noetini, whereas the other genera in the tribe Tephritini (Norrbon *et al.*, 1999a). *Ptosanthus* Munro, *Sphenella* Robineau-Desvoidy and *Telaletes* Munro belong to the *Sphenella* genus group (Freidberg, 1987; Norrbom *et al.*, 1999a), whereas the relationships of the two monotypic genera *Deroparia* Munro and *Namwambina* Munro are still not satisfactorily known. *Tanaica*, the last of these genera, was correctly associated with the *Campiglossa* genus group (Norrbon *et al.*, 1999a) because of the presence of setulose preglans area (absent only in *Antoxya* Munro and *Dioxyna* Frey), the flattened head and the mostly black setae on head and thorax.

The only species included in *Tanaica* by Munro (1957a) exhibits two unusual characters for the *Campiglossa* genus group and may have influenced the placement of the genus in the *Ensina* series: the entirely hyaline wing and the shining black abdomen. However, with the inclusion of the two species described below the concept of the genus is modified, including also species with faint reticulate wing pattern and with grey microtrichose abdomen. Superficially they resemble species of *Desmella* Munro and *Dioxyna*. Whereas the latter genus is somewhat isolated by the lack of setulae on the preglans area, it is possible to separate safely *Desmella* from *Tanaica* only by the structure of the glans. More careful comparative studies of all included species are, however, needed to establish whether both genera may be maintained or eventually be synonymized.

In order to place *Tanaica* in the *Campiglossa* genus group, a key to the Afrotropical and Near Eastern genera is provided. Excluded are *Homoeotricha* Hering

(6 species in Central and Eastern Palaearctic, to the west to Kazakhstan and Kyrgyzzia) and *Oxyparna* Korneyev (2 species in mountains between Kyrgyzzia and China).

- 1 One pair of frontal setae present (rarely on one side 2-3 frontal setae present, in these cases lunule very high and scape white setulose) . . . . . 2
- 1\* At least 2 pairs of subequal frontal setae present; scape always black setulose . . . . . 3
- 2 Scape black setulose; frons setulose anteriorly; lunule normal; posterior notopleural seta black; postpedicel about twice as long as wide . . . . . *Antoxya* Munro  
[1 Afrotropical species; *A. oxynoides* (Bezzi)]
- 2\* Scape white setulose; frons bare; lunule very high, a semicircle; posterior notopleural seta usually white; postpedicel barely longer than wide . . . . . *Oxya* Robineau-Desvoidy  
[23 species in Nearctic and Palaearctic Regions]
- 3 Apical scutellar setae at least 0.75 times as long as basal scutellar setae . . . . . 4
- 3\* Apical scutellar setae at most 0.6 times as long as basal scutellar setae, or entirely absent . . . . . 5
- 4 Labella long geniculate, longer than height of head (as in Fig. 24) . . . . . *Mesoclanis* Munro  
[8 Afrotropical and 1 Oriental species; 1 species introduced to Australia]
- 4\* Labella short geniculate, much shorter than height of head . . . . . *Scedella* Munro  
[15 Afrotropical and 2 Oriental/Australasian species]
- 5 Apical scutellar setae entirely absent . . . . . 6
- 5\* Apical scutellar setae present, though sometimes only little longer than surrounding setulae . . . . . 7
- 6 Head in profile higher than long; labella about 0.8 times as long as height of head; gena 0.2 times as high as eye and about as high as width of postpedicel; abdominal tergites dull, with indistinct paired spots on tergites 3-5; male: preglans area setulose . . . . . *Lethyna* Munro  
[7 Afrotropical species, 1 unidentified species in Yemen (Merz *et al.*, in press)]
- 6\* Head in profile wider than long; labella longer than height of head; gena at most 0.15 times as high as eye; about 0.7 times as high as width of postpedicel; paired spots on abdominal tergites distinct; male: preglans area bare . . . . . *Dioxyna* Frey, part  
[10 species, worldwide distribution]
- 7 Posterior notopleural seta white . . . . . *Campiglossa* Rondani, part  
[almost 200 species worldwide, most diverse in Afrotropical, Nearctic and Palaearctic Regions]
- 7\* Posterior notopleural seta black . . . . . 8
- 8 Dorsocentral seta distinctly posterior to level of postsutural supra-alar seta; head flattened . . . . . *Campiglossa* Rondani, part  
[here only *C. martii* (Becker) from the Canary Islands and Southern Spain]
- 8\* Dorsocentral seta closer to suture than to postsutural supra-alar seta; shape of head variable . . . . . 9



- 9 Head in profile higher than long; labella usually shorter than height of head; wing pattern usually reticulate, rarely banded; male: preglans area setulose ..... *Campiglossa* Rondani, part [see couplet 7]
- 9\* Head in profile flattened, longer than high; labella longer than height of head, usually projecting beyond vibrissal corner; other characters variable . . 10
- 10 Wing pattern strong, usually of banded appearance, with clear contrast between brown and hyaline areas; pterostigma uniformly brown without central hyaline spot; femora at least in basal half black; male: preglans area setulose ..... *Desmella* Munro [3 Afrotropical and 2 Palearctic species]
- 10\* Wing pattern weak, reticulate, or wing entirely hyaline; border between brown and hyaline areas indistinct; pterostigma uniformly hyaline or brown with central hyaline spot; femora yellow or partly black; male: preglans area setulose or bare ..... 11
- 11 At least midfemur mostly yellow. Male: preglans area bare . *Dioxyna* Frey, part [here only the Palearctic species *D. bidentis* (Robineau-Desvoidy) with short apical scutellar setae]
- 11\* All femora at least in basal 0.7 black. Male: preglans area setulose (Figs 20, 29) ..... *Tanaica* Munro [3 Afrotropical species, see below]

#### Key to species of *Tanaica* Munro, 1957

- 1 Wing with faint, but distinct reticulate pattern (Fig. 15); abdomen grey microtrichose, not shining ..... *T. maculata* sp. n.
- 1\* Wing entirely hyaline, at most pterostigma yellowish (Fig. 25); abdomen variable ..... 2
- 2 Abdomen strongly microtrichose, mat ..... *T. pollinosa* sp. n.
- 2\* Abdomen shining black, only very thinly microtrichose ..... *T. hyalipennis* (Bezzi, 1924)

#### *Tanaica hyalipennis* (Bezzi, 1924)

*Ensina hyalipennis* Bezzi, 1924: 549. Holotype ♀: SOUTH AFRICA: Cape, Cedarbergen, Clanwilliam, 4000-5000 ft, IX. 1923, leg. K. H. Barnard (SAMCT) (not examined).

*Material*. 1 ♂, 2 ♀ ♀, NAMIBIA: Keetmanshoop, 12.IX.2003, leg. A. Freidberg (TAU).

*Remarks*. The species was extensively described by Bezzi (1924), and redescribed by Munro (1929, 1957a) by adding new characters. Munro (1929) stated that the abdomen is shining black in the holotype, whereas it was described as «black, grey dusted» by Bezzi (1924). Because it was not possible to study the holotype we assume here that Munro correctly interpreted the colour of the abdomen. On the other hand, the illustration of the glans by Munro (1957a) is misleading because the distal two sclerotizations were not illustrated nor mentioned in the description. It is possible that he studied a teneral specimen with the sclerotization not yet fully developed. The above



mentioned male was dissected and it was found that the terminalia are the same as in *T. pollinosa* (Figs 27-30). According to available information (Munro, 1957a; Norrbom *et al.*, 1999b) *T. hyalipennis* has a rather narrow distribution in the Western part of South Africa and Namibia. This species was reared from *Chrysanthemoides monilifera* (Asteraceae) (Munro, 1957a).

***Tanaica maculata* sp. n.**

Figs 14-23

**Material.** Holotype ♂: SAUDI ARABIA: Abha, Madenate Ameer Sultan, 22.II.-25.V.2002, H. A. Dawah (MHNG). Paratypes: SAUDI ARABIA: 2♂♂, 3♀♀, same data as holotype (CHD, MHNG, NMWC). ETHIOPIA: 15♂♂, 9♀♀, Mojo, 75 km SE Addis Abeba, 20.XII.1989, A. Freidberg & F. Kaplan (MHNG, TAU). KENYA: 1♂, W-Nariobi (ILRAD), 1900 m, 1.III.1993, leg. B. Merz; 9♂♂, 5♀♀, same data, but 2.III.1993; 1♀, same data, but 3.III.1993; 1♀, same data, but 5.III.1993; 1♂, 2♀♀, same data, but 8.III.1993; 1♂, 2♀♀, same data, but 16.III.1993; 2♂♂, 40 km SE Nairobi, [on road] A 109, 1650 m, 17.III.1993, leg. B. Merz; 3♂♂, 75 km SE Nairobi (A 109), 1700 m, 17.III.1993; 1♀, 135 km SE Nairobi (A 109), 1200 m, 17.III.1993, leg. B. Merz (MHNG); 1♂, Rt. 104, 15 km SE Nairobi, 29.IV.-15.V.1991, A. Freidberg & F. Kaplan (TAU). The holotype is double-mounted on a minutien pin on a polyporus block and is in good condition with the right postocular seta and the right dorsocentral seta broken off and scutum slightly sunken medially.

**Etymology.** The name refers to the patterned wing, which is unique among known species of the genus.

**Diagnosis.** Within *Tanaica* this species is easily recognizable by the presence of a reticulate, weak wing pattern (Fig. 15). Cell r1 with 3 hyaline spots. The other two species of the genus have an entirely hyaline wing. The abdomen is microtrichose as in *T. pollinosa*.

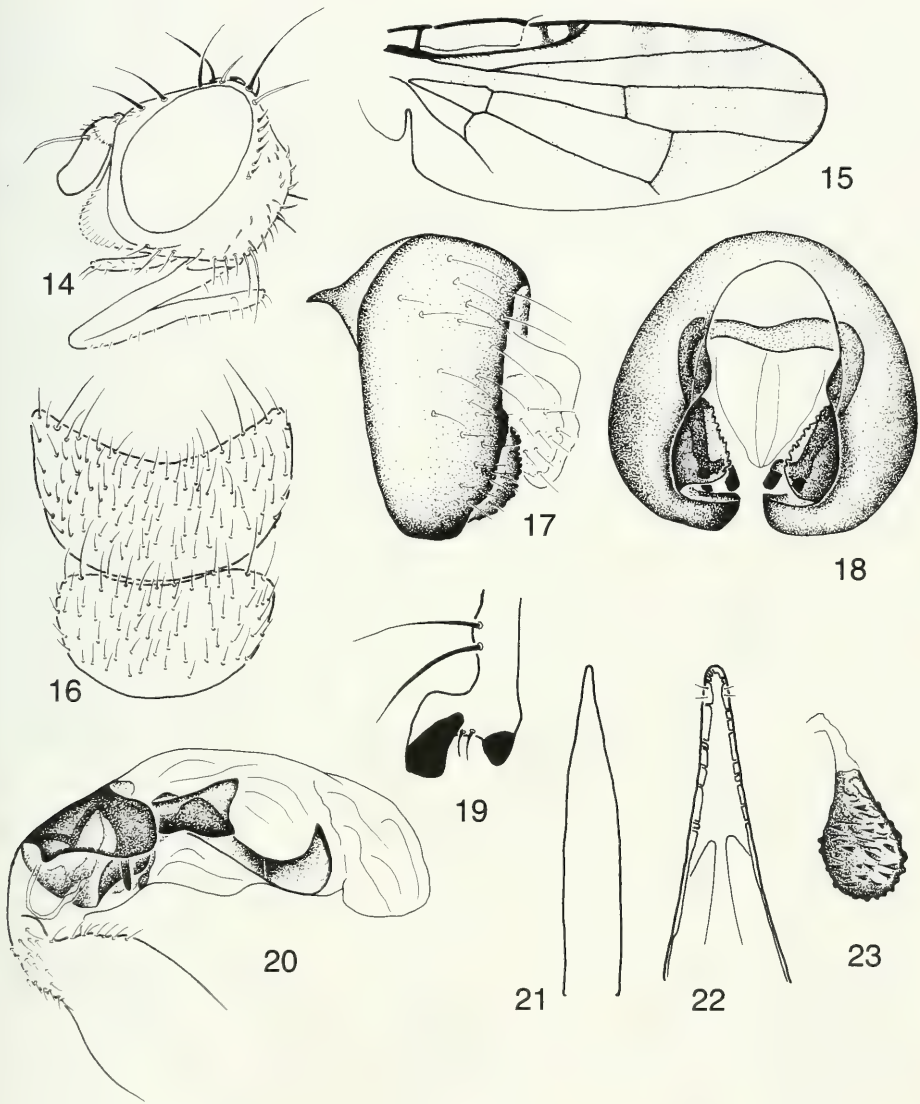
**Description.** WING LENGTH. Male: 2.1-3.4 mm; female: 2.0-3.5 mm.

**HEAD** (Fig. 14). Ground colour mat yellow; face, gena and parafacial whitish yellow; frons and antennae orange-yellow. In profile slightly wider than high, with swollen occiput; gena about 1/8 as high as eye, the latter about 1.3 times as high as wide; vibrissal corner strongly projecting beyond anterior base of antennae; frons bare, sides slightly converging towards lunule; interfrontal stripe indistinct, only visible as whitish line under certain angle; paraverticlar seta white, short, not longer than setulae on ventral half of occiput.

**THORAX.** Mesonotum black, densely ash-grey to silvery grey microtrichose, with traces of 3 brown longitudinal stripes over lines of dorsocentral setae and in middle; postpronotum and tip of scutellum yellowish; scutum covered with very dense, white setulae; setulae on pleura less numerous; prosternum white setulose. Chaetotaxy as described for the genus.

**LEGS.** As described for the genus.

**WING** (Fig. 15). With a weak reticulate pattern; cell c often with a pale brown mark in middle; pterostigma brown with a hyaline spot in middle or uniformly yellow; r1 with 3 hyaline spots; preapically on level of tip of R2+3 with 4 large spots in one line; apex of wing with small hyaline spot; remaining pattern faint, especially in anal lobe.



FIGS 14-23

*Tanaica maculata* sp. n. (16-20, male; 21-23, female, paratypes from Abha): 14, head, lateral view; 15, wing; 16, abdominal sternites 4 and 5; 17, epandrium, lateral view; 18, same, caudal view; 19, medial surstylus with prensisetae enlarged; 20, aculeus; 22, tip of aculeus; 23, spermatheca (only one illustrated).

ABDOMEN MALE. Preabdomen as in *T. pollinosa*. Terminalia (Figs 16-20). Epandrium (Fig. 18) ovoid, black, but epandrial process brown; the latter with serrate border, visible in lateral view (Fig. 17); medial surstylus with two unequal prensisetae present on prominent plate, the lateral prensiseta much larger than the medial (Fig. 19); pregans area with 2 rows of short setulae; glans (Fig. 20) with well sclerotized basal

acrophallus and with 2 sclerites in vesica, of which one is long, apically pointed and medially curved and the other sclerite is short, widening apically with concave distal margin.

**ABDOMEN FEMALE.** In all characters, including terminalia (Figs 21-23) as in *T. pollinosa* (see below).

**Distribution.** Ethiopia, Kenya, Saudi Arabia.

**Host plants.** Unknown. The specimens from Kenya were swept from various herbs in grassland areas, whereas the specimens from Saudi Arabia were collected in a Malaise trap.

**Pest status.** Not a pest species.

**Remarks.** This species is easy to recognize within *Tanaica* by the reticulate wing pattern. The species is somewhat variable in wing pattern. Specimens from Ethiopia and Kenya tend to have a weaker pattern, with notably cell c entirely hyaline (without central darker spot) and with pterostigma uniformly yellow (in Saudi Arabian specimens usually brown with central hyaline spot). However, male and female terminalia are the same for populations from Kenya and Saudi Arabia, and few specimens from Kenya have the same wing pattern as those from Saudi Arabia. At the present moment it is not possible to decide whether these populations represent different species. Further studies, in particular the knowledge of host plants, would give further evidence about their status.

*T. maculata* has the same type of wing pattern as do some *Dioxyna* Frey. However, all *Dioxyna* lack the two rows of setulae on the preglans area (present in *Tanaica*). Moreover, they lack, except for *D. bidentis*, the apical scutellar setae. The latter species differs from *T. maculata* by the almost entirely yellow legs (femora blackish in *T. maculata*).

### *Tanaica pollinosa* sp. n.

Figs 24-33

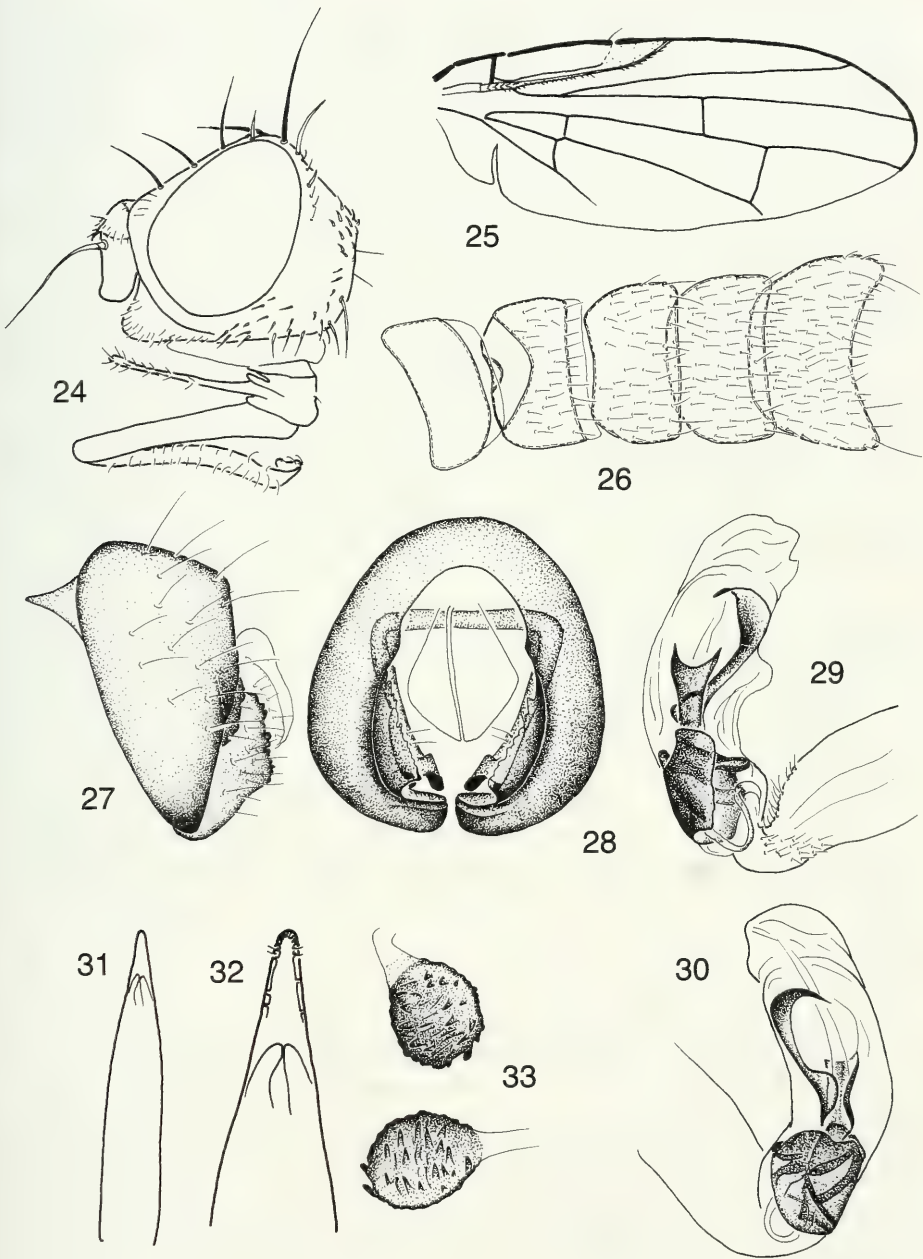
**Material.** Holotype ♂: SAUDI ARABIA: Abha, Madenat Ameer Sultan, 22.II.-25.V.2002, H. A. Dawah (MHNG). Paratypes: SAUDI ARABIA: 1 ♂, 2 ♀, same data as holotype (CHD, MHNG). SOUTH AFRICA: 3 ♂♂, 2 ♀♀, N Transvaal, Sautpansberg, 1500 m, 15km NW Louis Trichardt, 25.XII.1994, A. Freidberg. The 2 ♀♀ with additional label: ex ? seeds *Tripteris auriculata*, 1.I.1995 (TAU, MHNG). The holotype is double-mounted on a minuten pin on a polyporus block and is in good condition with few setae on head and thorax broken off.

**Etymology.** The name refers to the grey microtrichose abdomen.

**Diagnosis.** This species differs from the other species from Saudi Arabia by its entirely hyaline wing without traces of a pattern (Fig. 25). The abdomen is densely grey microtrichose; tergites 2-5 each with a pair of indistinct brown spots.

**Description.** WING LENGTH (both sexes). 2.4-2.6 mm.

**HEAD** (Fig. 24). Ground colour mat yellow, but occiput and ocellar triangle black; face and gena whitish yellow; frons and antenna orange-yellow. Head in profile wider than high, with prominent occiput; gena narrow, less than one sixth as high as compound eye; the latter ovoid, about 1.25 times as high as wide; vibrissal corner projecting beyond level of antennal base; frons bare; interfrontal stripe indistinct, narrow, almost white; paravertical seta white, shorter than posterior orbital seta.



FIGS 24-33

*Tanaica pollinosa* sp. n. (24-30, male; 31-33, female, paratypes from Abha): 24, head, lateral view; 25, wing; 26, abdominal sternites; 27, epandrium, lateral view; 28, same, caudal view; 29, glans, lateral view; 30, glans, frontal view; 31, aculeus; 32, tip of aculeus; 33, spermathecae.



**THORAX.** Mesonotum black, densely silvery grey microtrichose; postpronotal lobe and posterior half of scutellum yellow; scutum densely covered with white, lanceolate setulae; pleura slightly darker grey, setulae on anepisternum, katapisternum and anepimeron less numerous and more acuminate; prosternum grey, white setulose. Chaetotaxy as described for the genus.

**LEGS.** As described for the genus.

**WING** (Fig. 25). Entirely hyaline, only stigma faintly yellowish.

**ABDOMEN MALE.** Tergites darker grey than mesonotum, but still distinctly golden-grey microtrichose; each tergite with a pair of almost parallel-sided spots which are forming a more or less uniform band from base to tip of abdomen; setulae short, dense, lanceolate; sternites (Fig. 26) darker grey, sparsely setulose; sternite 5 shallowly concave with smooth apicolateral corners; epandrium (Figs 27-28) black, but epandrial process brown; the latter prominent and distinctly projecting, with serrate border; inner terminalia as usual in tribe; aedeagus (Figs. 29-30) with 2 rows of setulae on preglans area; glans with strong basal sclerotization and 2 curved, unevenly long plates forming an open tube; the longer apically pointed and strongly curved medially; the shorter plate distinctly widening distally, forming an open rim; vesica as broad as acrophallus, distally truncate, rather small.

**ABDOMEN FEMALE** (Figs 31-33). Coloration and chaetotaxy of pregenital segments as male; oviscapae black, fine setulose, without white setae, as long as preceding 3 tergites combined; aculeus apically evenly pointed, without step; 2 almost spherical spermathecae, covered with short papillae; aculeus length: 0.77 mm ( $n = 1$ ).

*Distribution.* Saudi Arabia, South Africa.

*Host plant.* *Tripteris auriculata* (Asteraceae).

*Pest status.* Not a pest species.

*Remarks.* This species differs from *T. hyalipennis* (Bezzi), the other species with entirely hyaline wings, only in the colouration of the abdomen. It is shining black in the latter, but grey microtrichose in *T. pollinosa*. All other external characters and the terminalia of both sexes are the same in both species.

### *Spathulina* genus group

#### *Spathulina acroleuca* (Schiner, 1868)

*Material. 2:* 2 ♀♀.

*Distribution.* Widespread in the Afrotropical, Southern Palaearctic, Oriental and Australasian Regions. Recorded from Yemen by Merz *et al.* (in press). New for Saudi Arabia.

*Host plants.* Various Asteraceae, such as *Bidens*, *Ceruana*, *Matricaria* and *Spilanthes* (Munro, 1938).

*Pest status.* The species was recorded as minor pest on Mexican sunflower (*Tithonia diversifolia*) in the Philippines (White & Elson-Harris, 1992).

### *Sphenella* genus group

#### *Sphenella marginata* (Fallén, 1814)

*Material. 2:* 1 ♂, 1 ♀.

*Distribution.* Palaearctic and Afrotropical Regions. New for Saudi Arabia.

*Host plants.* *Senecio* spp. (Asteraceae) (Freidberg & Kugler, 1989; Merz, 1994).

*Pest status.* May be important in the natural regulation of those *Senecio* spp. which are weeds in some parts of the world (White & Elson-Harris, 1992).

*Remarks.* After the study of large series from the Palaearctic and Afrotropical Regions we conclude that the differences given to separate *S. marginata* s.str. (Palaearctic subspecies) from *S. marginata austrina* Munro, 1957 (Afrotropical subspecies) (Munro, 1957b) are unreliable with many intermediate specimens known. The two taxa are considered here to belong to the same species and they are herewith synonymized (**syn. n.**).

***Sphenella setosa* sp. n.**

Figs 34-41

*Material.* Holotype ♂: «SAUDI ARABIA: Aseer, Abha, Farm Centre, 14.IV.2001, H. A. Dawah»; «Tephritis sp. ♂, lower angle anal cell more prominent than any sp. photo in Die Fliegen» [J. C. Deeming's handwriting] (MHNG). Paratype: 1 ♂, SAUDI ARABIA: Aseer, Abha, Farm Centre, 14.IV.2001, H. A. Dawah (MHNG). The holotype is glued laterally on a card point, and is in good condition with left arista and few setae missing (left ocellar seta, few postocular setulae, left postpronotal seta, both left notopleural setae, left presutural supra-alar seta; left postsutural supra-alar seta; both right scutellar setae).

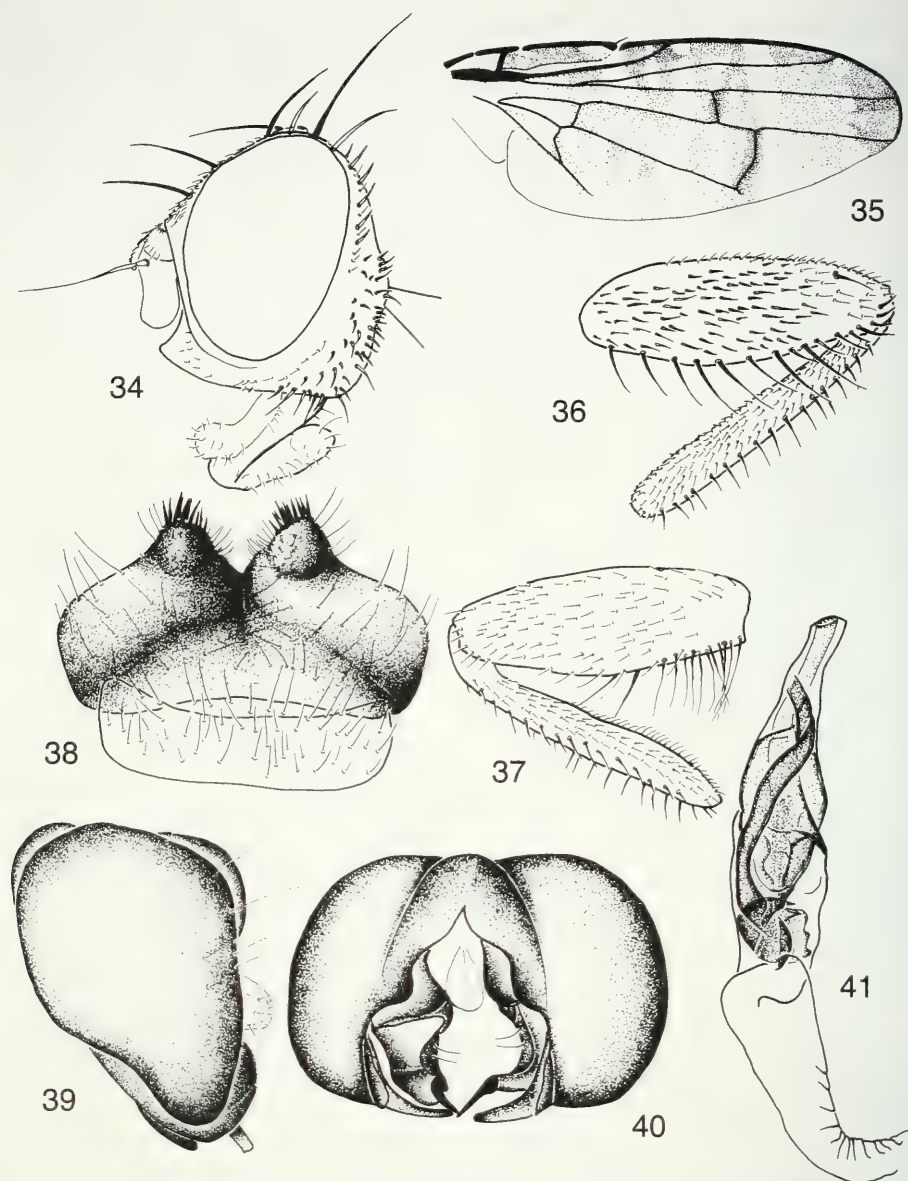
*Etymology.* The name refers to the strongly setulose legs.

*Diagnosis.* This species differs from all described *Sphenella* by the strongly setulose hindfemur and hindtibia (Figs 36-37), the wing (Fig. 35) with the ill-defined pattern of paler and darker areas on the entire surface, the strongly modified sternite 5 with 2 medial tubercles (Fig. 38), and the very large, black, globose epandrium (Fig. 40). The wing pattern resembles superficially species of *Paratephritis* Shiraki, *Telaletes* Munro and *Orotava* Frey, but the combination of bare R4+5, flat scutellum, presence of anteroventral setae on hindfemur and presence of only one long, pointed preniseta on the medial surstylus are typical for *Sphenella*. Other diagnostic characters of this species are the mixed white and black postocular setulae, the yellow legs with only hindfemur black in basal half, the yellow postpedicel, and the sclerotization of the glans.

*Description* (male only). WING LENGTH. 3.50-3.75 mm.

**HEAD** (Fig. 34). Mat yellow, but ocellar triangle and occiput grey microtrichose. In profile 1.25 times as high as long, gena 0.15 times as high as compound eye; fronto-facial angle about 110°; frons white setulose anteriorly; frontal plate rather densely white setulose; face distinctly concave, without carina; vibrissal corner white setulose; gena dorsally black and ventrally white setulose. Antenna yellow, scape with white setulae, pedicel with black setulae; postpedicel apicodorsally slightly pointed; arista virtually bare. Mouthparts short geniculate, labella fleshy, not extending beyond vibrissal corner. Chaetotaxy: 2 black frontal setae; 1 black anterior and 1 white, shorter posterior orbital seta; 1 black ocellar seta; 1 black medial vertical seta; 1 white lateral vertical seta; 1 white postocellar seta; 1 white paraverticlar seta; postocular setulae mixed white and black.

**THORAX.** Scutum densely golden grey microtrichose, in dorsal and posterior view with 3 faint brown longitudinal stripes on lines of dorsocentral setae and in



FIGS 34-41

*Sphenella setosa* sp. n. (male paratype): 34, head, lateral view; 35, wing; 36, hind leg, anterior view; 37, hind leg, posterior view; 38, abdominal sternites 4 and 5; 39, epandrium, lateral view; 40, same, caudal view; 41, glans.

middle; entire surface covered densely with white setulae; scutellum flat, mat yellow, white setulose laterally; pleura slightly more ash-grey than scutum; anepisternum and anepimeron white setulose; prosternum densely white setulose. The following setae are black: 1 postpronotal seta; 2 notopleural setae (posterior notopleural seta about half as



long as anterior notopleural seta); 1 dorsocentral seta, which is inserted well posterior of suture, about at level of anterior wing base; 1 presutural supra-alar seta; 1 post-sutural supra-alar seta; 1 intra-alar seta; 1 postalar seta; 2 (pairs of) scutellar setae which are of same length; 1 katepisternal seta. Anepisternal seta and anepimeral seta white.

**LEGS** (Figs 36-37). Ground colour yellow, forecoxa whitish yellow, other parts brownish yellow; midfemur posteriorly at base with black stripe; hindfemur in anterior half black. All femora rather stout, conspicuously setulose; hindfemur with a row of long, black setae anteroventrally (Fig. 36), one strong, black anterodorsal seta, and with numerous soft, whitish, very long setulae (about as long as diameter of femur) posteroventrally in basal third (Fig. 37). Hindtibia anterodorsally and posterodorsally each with a row of conspicuous, outstanding, black setulae.

**WING** (Fig. 35). R4+5 bare on both sides; R1 setulose dorsally, with gap on level of subcostal break; ventrally with few setulae in distal half of pterostigma. Pattern brown to yellow brown, indistinctly striped, with darker areas along C, at wing tip, and around crossveins; other parts with a pattern of ill-defined subhyaline spots on pale brown surface.

**ABDOMEN**. Mat ash-grey microtrichose with yellow hind margins of tergites 2-5; tergite 5 about twice as long as tergite 4; all tergites white setulose, only tergite 5 posteriorly with a row of black setulae.

**MALE TERMINALIA**. Sternite 5 (Fig. 38) greatly modified, much larger than preceding sternites; apically with two medial bulbous projections, which are separated by a cleft and which bear apically about 12 stout, black setulae; other setulae rather soft, pale. Epandrium (Figs 39-40) very large, globose, black; epandrial process small, only little projecting; lateral surstylus separated from epandrium by a fold, strongly bent medially and pointed apically; medial surstylus with one very long, spine-like black preniseta, which is directed posteriorly; hypandrium as in other species of the genus; glans (Fig. 41) rather narrow, tapered apically and truncated, with a strongly sclerotized ductus.

*Distribution*. Saudi Arabia.

*Host plants*. Unknown.

*Pest status*. Not a pest species.

*Remarks*. This species keys out readily in Munro (1957b) in couplet 4 as *Sphenella* with the setulose hindfemur anteroventrally, the bare vein R4+5, and the flat scutellum. In addition, only one long, pointed preniseta is developed. Sternite 5 carries apicomediaally two tubercles as in other species of *Sphenella* but they are much more developed and they are covered with more conspicuous black setae posteriorly. Wing pattern, however, is very different, as other species of *Sphenella* have large hyaline areas, and the black areas are usually clearly delimited. In this respect *S. setosa* resembles some species of *Paratephritis* Shiraki, *Telaletes* Munro, and *Orotava* Frey, which have the same indistinct reticulation with the ill-defined hyaline spots and the brown stripe over DM-Cu. Within *Sphenella* the new species exhibits, in addition to the wing pattern and the structure of sternite 5, a number of unique characters: hindfemur with row of black setulae anteroventrally on entire length (in other species of *Sphenella* only near apex with few setulae) with white setulae in basal third postero-



ventrally (not present in other *Sphenella*); epandrium shining black and globose (much more elongated and less conspicuous in other *Sphenella*).

***Telaletes ochraceus* (Loew, 1861)**

*Material.* 1: 2♂♂; 2: 1♂, 1♀.

*Distribution.* East Africa. New to Saudi Arabia.

*Host plants.* Unknown.

*Pest status.* Not a pest species.

***Tephritis* genus group**

***Arabodesis* gen. n.**

Gen. nr. *Trupanodesis* Merz - Merz *et al.* (in press).

*Type species.* *Arabodesis reductiseta* sp. n.

*Etymology.* The name refers to the distribution in Arabia and its resemblance to *Trupanodesis* Merz and *Tephrodesis* Merz. Gender is feminine.

*Diagnosis.* The new genus belongs to the *Tephritis* group as defined by Merz (1999). The absence of medial postocellar setae (Fig. 43), the presence of only white postocular setae (Fig. 42), two (pairs of) subequal scutellar setae (Fig. 45) and the rather simple structure of the glans with short vesica (Fig. 50) place *Arabodesis* close to *Tephrodesis* and *Trupanodesis*. It differs from these genera by the black posterior notopleural seta, the dorsocentral seta situated well behind the transverse suture at level of postsutural supra-alar seta (Fig. 45), the convex lower calypter, the rather conspicuous posterodistal extension of cell *bcu* (Fig. 46), and the aculeus with an apical step (Fig. 53).

*Description.* HEAD (Figs. 42-44). In profile at least 1.5 times as high as long, gena and parafacial narrow; vibrissal corner projecting anteriorly; frons parallel-sided, narrow, longer than wide, with few tiny, fine, white setulae on interfrontal stripe; ocellar triangle with few white setulae between ocelli; scape white setulose and pedicel black setulose; postpedicel (Fig. 44) about twice as long as wide; arista almost bare; proboscis capitate; palpus not projecting beyond anterior margin of vibrissal corner. Chaetotaxy: 1-2 frontal seta, 1 orbital seta, 1 ocellar seta and 1 long medial vertical seta black, acuminate; postocellar seta, lateral vertical seta and row of postocular setae white, lanceolate; medial postocellar seta absent.

THORAX (Fig. 45). Shape as in other genera of the *Tephritis*-group; scutum covered with white setulae. Chaetotaxy: scapular setae absent; setae on thorax black, including posterior notopleural seta, only anepimeral seta white; 1 postpronotal seta; 2 notopleural setae, the posterior shorter; 1 presutural supra-alar seta; 1 postsutural supra-alar seta; 1 intra-alar seta; 1 postalar seta; 1 acrostichal seta; 1 dorsocentral seta well behind transverse suture, about at level of postsutural supra-alar seta; 2 (pairs of) subequal, strong scutellar setae; 1 anepisternal seta; 1 katepisternal seta; 1 anepimeral seta; prosternum white setulose.

LEGS. Hindfemur anteroventrally with 1-2 outstanding, longer setulae at tip; midtibia apicoventrally with one black seta.

WING (Fig. 46). Stigma about twice as long as wide; R-M crossvein situated in distal third of cell *dm*; distance between crossveins about 0.8 times as long as DM-Cu;

posterodistal extension of bcu distinct; veins bare, but R1 dorsally setulose except for gap on level of tip of Sc, ventrally with 0-2 setulae at tip of pterostigma. Both calypters with convex distal border, of subequal width.

**ABDOMEN MALE.** Densely white setulose, without longer setae; sternite 5 (Fig. 47) over 1.3 times as wide as sternite 4, distally smoothly concave; epandrium (Figs 48-49) ventrally very wide, bulging, fused with lateral surstyli, the latter unmodified; epandrial process present but not very prominent; medial surstylus with 2 subequal prenisetae and 2-3 setulae on plate; hypandrium and associated structures as usual for the *Tephritis* group, with unpaired hypandrial arms; distiphallus long, coiled, preglans area bare; glans (Fig. 50) with rather simple sclerotization; sclerotized ductus apically with few small spines; vesica short.

**ABDOMEN FEMALE.** Preabdomen as male; tergites 5 and 6 subequal; oviscape (Fig. 51) white setulose, at distal margin with numerous soft setulae; aculeus (Figs 52-53) with apical step; 2 spermathecae, covered with small papillae (Fig. 54).

*Remarks.* *Arabodesis* is a puzzling genus which exhibits an unusual combination of characters rendering its placement within the family difficult. Lack of scapular setae, the presence of only white postocular setae, and the gap of setulae on R1 opposite tip of Sc show that it belongs to the Tephritini. Based on the revisions of some genus groups within the tribe by Freidberg (1987, *Sphenella* group), Korneyev (1990, *Campiglossa* group) and Merz (1999, *Tephritis* group) it can be concluded that the new genus shares the synapomorphies of the *Tephritis* group as defined by Merz (1999): glans rather simple, weakly sclerotized and the presence of capitate mouthparts. Within the *Tephritis* group, *Arabodesis* exhibits a number of plesiomorphic character states, such as (1) the absence of medial postocellar setae (apomorphic state (= A): medial postocellar setae present), (2) the black posterior notopleural seta (A: white), (3) the position of the dorsocentral seta well behind the suture (A: almost on level of suture), (4) the rather large lower calypter with convex margin (A: small, stripe-like lower calypter with straight margin), and (5) the apical step of the aculeus (A: aculeus evenly pointed), although the polarity of the latter character is unresolved. A black posterior notopleural seta is known in the *Tephritis* group only from few *Tephritis* (*arnicae* (Linnaeus), *conura* (Loew)). The position of the dorsocentral seta is comparable only with *Euarestella* Hendel, which belongs to the *Goniurellia* clade (medial postocellar setae present; in addition, this genus has 2+1 frontal and 2 orbital setae). The large lower calypter is only known from *Tephritis* Latreille (but this genus has 2 frontal and 2 orbital setae; head shape is different, and the dorsocentral seta is almost on level of suture). The apical step on the aculeus is developed in the *Tephritis* group only in some *Tephritis* (*pulchra* group) but an apical step is widespread in many genera of Tephritini.

*Arabodesis* shares with *Tephrodesis* Merz a similar type of glans of aedeagus, which is evidence for a sister-group relationship and this character may be a good synapomorphy for these two genera. However, the position of *Tephrodesis* within the *Tephritis* group is not well understood, as its sister-group relationships are unknown (Merz, 1999). *Tephrodesis* differs from *Arabodesis* by the development of the apomorphic character states of characters (2) to (5) mentioned above, but also by the patterned wing, the 2+1 frontal and 2 orbital setae, and a black oviscape. Further, it

lacks the small spinules on the inner side of the ductus of the glans which are characteristic for *Arabodesis*.

Autapomorphies of *Arabodesis* are probably the presence of (a) only 1 orbital seta (in Tephritini very rare, only known from *Actinoptera* Rondani, but this genus differs in addition to the apomorphic character states (2) – (5) listed above by the very small pterostigma and a patterned wing), (b) the very high head (otherwise only in *Hyalotephritis* Freidberg, but this genus has the apomorphic character states (1) – (5), and different male terminalia) and (c) the large posterodistal extension of cell bcu (less conspicuous in other species of the *Tephritis* group).

In the key of Merz (1999) the new genus runs to couplet 11 which needs to be modified as follows:

- 11     One black orbital seta present; posterior notopleural seta black; dorso-central seta almost at level of postsutural supra-alar seta; wing entirely hyaline ..... *Arabodesis* gen. n.
- 11\*    Two orbital setae present; posterior notopleural seta white; dorsocentral seta closer to suture than to postsutural supra-alar seta; wing usually with pattern, though sometimes weak ..... 11a
- 11a    Two concolourous frontal setae present ..... 12
- 11a\*   Three frontal setae, the anteriormost seta sometimes white ..... 13

This genus was first mentioned, but not formally described from Yemen based on three badly preserved specimens belonging to two species differing chiefly in the chaetotaxy of the head (Merz *et al.*, in press).

***Arabodesis reductiseta* sp. n.**

Figs 42-54

Gen. nr. *Trupanodesis*, sp. 1 - Merz *et al.* (in press).

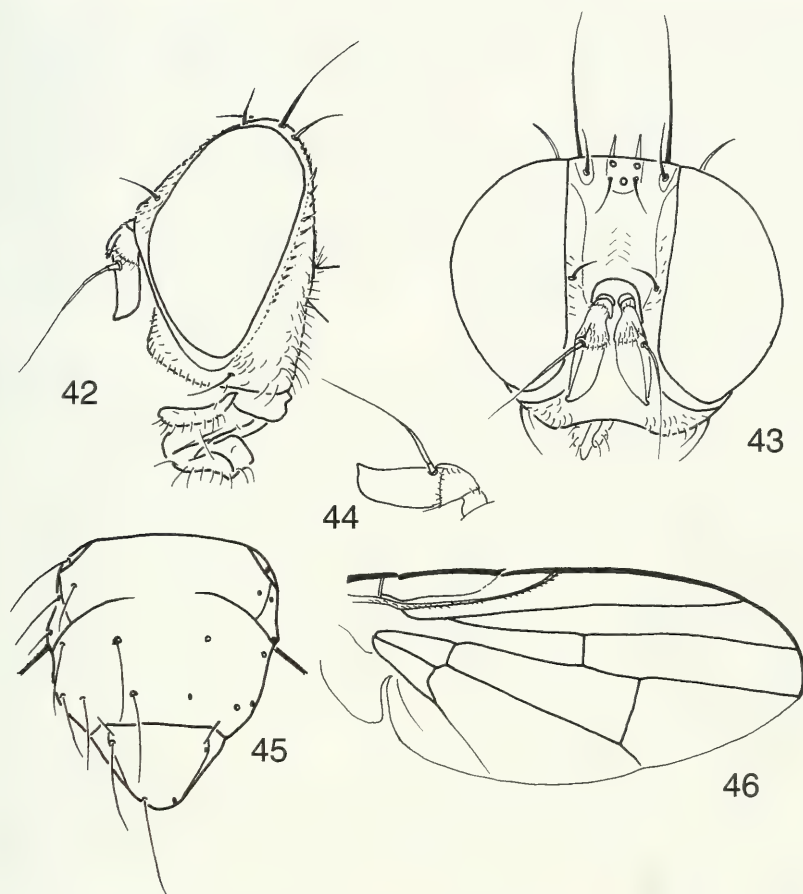
**Material.** Holotype ♀: SAUDI ARABIA: Abha, Madenate Ameer Sultan, 22.II.-25.V.2002, H. A. Dawah (MHNG). Paratypes: SAUDI ARABIA: 5♂♂, 15♀♀, same data as holotype (CHD, MHNG, NMWC, TAU). YEMEN: 1♂, 1♀, San'a, light trap, 3.IV.1999, leg. A. von Harten (MHNG, ZMUA); 1♀, San'a, ca. 7900 ft., 10.-15.X.1937, D. Carl Rathjens, B.M. 1939-396, from Lucerne (NHML). The holotype is glued laterally on a cardpoint, and is in good condition but both wings folded over each other.

**Etymology.** The species is named for the small number of setae on the head.

**Diagnosis.** Easy to recognize by the presence of only 1 frontal and 1 orbital seta, both short, fine and black (Fig. 42); ocellar seta short; postpedicel with distinct dorso-apical point (Fig. 44); wing entirely hyaline (Fig. 45); male: epandrium medially strongly convex (Fig. 49), epandrial process in lateral view hardly visible (Fig. 48); glans with few small papillae near tip of ductus (Fig. 50); female: aculeus with apical step (Fig. 53).

**Description.** WING LENGTH. Male: 2.05-2.30 mm; female: 2.20-2.60 mm.

**HEAD** (Figs 42-43). Mat yellow, but ocellar triangle and occiput dorsal to occipital foramen ash grey microtrichose; head in profile 1.5-1.6 times as high as long; compound eye about 1.75 times as high as wide; gena about 1/6 as high as compound eye; only one weak frontal seta almost at level of antennal bases; 1 weak, reclinate



FIGS 42-46

*Arabodesis reductiseta* sp. n. (paratype from Abha): 42, head, lateral view; 43, head, frontal view; 44, antenna; 45, thorax, dorsal view; 46, wing.

orbital seta very high on head near vertex; all other setae also weak except for long medial vertical seta; postocular setae all white, short, in one row; pedicel without strong dorsal seta; postpedicel about twice as long as wide, with conspicuous dorso-apical point (Fig. 44).

**THORAX** (Fig. 45). Scutum, pleura and subscutellum mostly ash grey microtrichose; only postpronotal lobe, dorsal part of anepisternum, posterior half of notopleuron, most of prosternum and entire scutellum mat yellow; scutum covered with short, weak, white setulae; scutellum bare, but white setulose along margin; chaetotaxy as described for genus; halter yellow; both calypters yellow.

**LEGS.** Yellow, but hindfemur ventrally in middle with grey patch.

**WING** (Fig. 46). Entirely hyaline, only pterostigma slightly yellowish.

**ABDOMEN MALE** (Figs. 47-50). Mat ash grey microtrichose; posterior margin of tergites with yellow transversal stripes, broader on syntergite 1+2 than on posterior



tergites; sternites yellow, each with a pair of grey spots (Fig. 47); sclerotization of glans compact (Fig. 50); acrophallus with two internal ducts, which are crossing in distal half; near tip with few small papillae on inner side; vesica small, apically broadly rounded.

**ABDOMEN FEMALE** (Figs 51-54). Oviscape about as long as preceding 1-1.5 tergites combined, about 0.5 mm long; orange on surface, black at both sides and along a medial longitudinal stripe; aculeus with slightly concave margin in basal half and abruptly narrowing in apical third, tip with apical step; length about 0.45 mm.

*Distribution.* Saudi Arabia, Yemen.

*Host plants.* Unknown. All specimens were collected in Malaise traps.

*Pest status.* Not a pest species.

*Remarks.* At first glance *A. reductiseta* resembles species of *Hyalotephritis*, which is the only genus of the *Tephritis* group with species having entirely hyaline wings and a similar head shape. Chaetotaxy (especially absence of medial postocellar setae), position of the dorsocentral seta, colour of posterior notopleural seta, and presence of 1-2 anteroventral setulae on hindfemur near tip indicate immediately that the new species does not belong to the *Goniurellia* clade in the *Tephritis*-group (see also above). A second species of *Arabodesis* is known from Yemen (Merz *et al.*, in press). It differs from *A. reductiseta* by the stronger setae on the head, the presence of 2 frontal setae, and the postpedicel being dorso-apically rounded. As only one female is available, which is slightly shrivelled, this species is not formally described here.

### ***Capitites augur* (Frauenfeld, 1857)**

*Material.* 2: 2♂♂.

*Distribution.* Egypt, Israel, Sudan. Recorded from Saudi Arabia by Al-Ahmadi & Salem (1999, as *Trupanea augur*) and by Norrbom *et al.* (1999b, as *Paradesis augur*). It should be noted that this species was misidentified in the past, and its status was resolved by Freidberg & Kugler (1977). Therefore, it may be possible that old records refer to other species (*Goniurellia* spp.).

*Host plant.* *Pulicaria crispa* (Asteraceae) (Freidberg & Kugler, 1989, as *Dectodesis augur*).

*Pest status.* Not a pest species.

### ***Dectodesis auguralis* (Bezzi, 1908)**

*Material.* 2: 2♂♂, 1♀.

*Distribution.* Eastern Afrotropical Region from Eritrea to Zimbabwe, Yemen (Merz *et al.*, in press). New for Saudi Arabia.

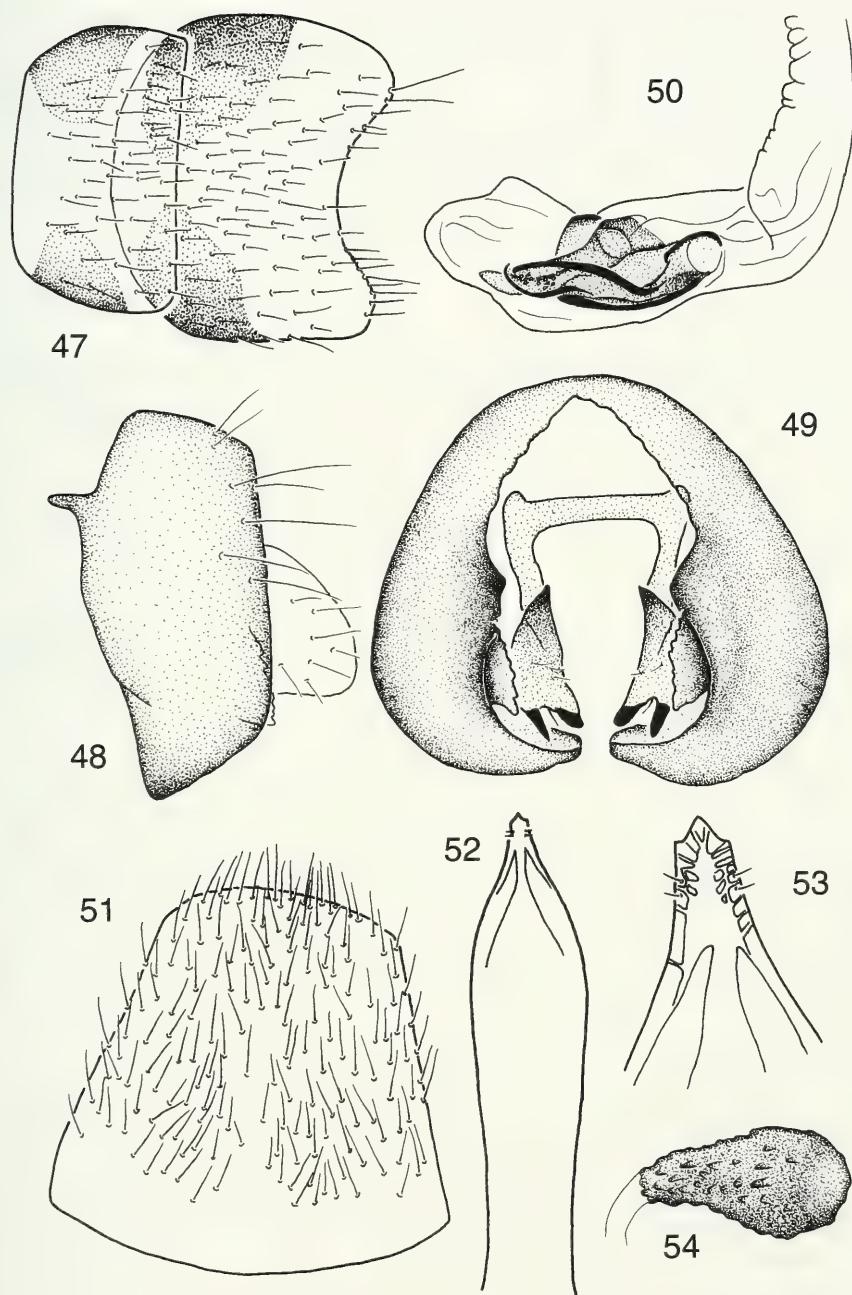
*Host plants.* Unknown, but other species of the genus live in flowerheads of *Erigeron*, *Helichrysum* and *Gnaphalium* (Asteraceae).

*Pest status.* Not a pest species.

### ***Dectodesis* sp. 1**

*Material.* 2: 1♂.

*Remarks.* This male lacks the head and is also otherwise in bad condition. It is very similar to the previous species, but the apical scutellar setae are absent. Judging from wing pattern and colour of mesonotum this species may belong to *D. confluens*



FIGS 47-54

*Arabodesis reductiseta* sp. n. (47-50, male; 51-54, female, paratypes from Abha): 47, abdominal sternites 4 and 5; 48, epandrium, lateral view; 49, same, caudal view; 50, glans; 51, oviscape; 52, aculeus; 53, tip of aculeus; 54, spermatheca (only one illustrated).

(Wiedemann, 1830), a very widespread and abundant species in Eastern and Southern Africa. Because of the poor condition of the specimen we are not naming it here.

***Freidbergia mirabilis* Merz, 1999**

*Material.* 2: 1 ♂.

*Distribution.* Described from Kenya and Ethiopia (Merz, 1999). New for Saudi Arabia.

*Host plants.* *Pluchea* spp. (Asteraceae) (Merz, 1999).

*Pest status.* Not a pest species.

***Goniurellia persignata* Freidberg, 1980**

*Material.* 1: 1 ♂; 2: 1 ♂, 2 ♀.

*Distribution.* From Sri Lanka and China in the East through Middle Asia and the Southern Mediterranean Region to Morocco. Also known from Ethiopia. New for Saudi Arabia.

*Host plant.* *Pulicaria arabica* (Asteraceae) (Freidberg, 1980).

*Pest status.* Not a pest species.

***Goniurellia spinifera* Freidberg, 1980**

*Material.* 2: 1 ♂, 1 ♀.

*Distribution.* Near East and North Eastern Afrotropical Region. Recorded from Saudi Arabia by Freidberg (1980).

*Host plant.* *Pulicaria desertorum* (Asteraceae) (Freidberg, 1980).

*Pest status.* Not a pest species.

***Hyalotephritis* Freidberg, 1979**

This genus was proposed by Freidberg (1979) for two species which are morphologically very similar: *H. complanata* (Munro) and *H. planiscutellata* (Becker). He provided a key and illustrated the main differences between the two species (head shape, structure of glans, aculeus tip). Larvae of both species live in flowerheads of *Conyza dioscoridis* (Asteraceae). The comparison of the 35 specimens from Saudi Arabia with numerous specimens of *H. planiscutellata* from Israel, Kenya and Oman, and two pairs of *H. complanata* from South Africa showed that both species are present in Saudi Arabia. It was observed that the structure of the glans is the only reliable character separating the two species, whereas head and aculeus shape are more variable. The glans of the Saudi Arabian specimens of *H. planiscutellata* fits the illustration of Freidberg (1979), but a notable difference could be found in the sclerotization of the glans in all specimens of *H. complanata* (Fig. 55), including one male from South Africa, compared with the illustration of Freidberg (1979, Fig. 13): The distal part of the sclerotized tube is longer and stronger, undulating, ending in a small apical sclerite which is darker than the previous part.

***Hyalotephritis complanata* (Munro, 1929)**

Fig. 55

*Material.* 2: 2 ♂♂, 3 ♀♀; 3: 7 ♂♂, 6 ♀♀.

*Distribution.* South and East Africa. New for Saudi Arabia.

*Host plant.* *Pluchea dioscoridis* (Asteraceae) (Freidberg, 1979).

*Pest status.* Not a pest species.

*Remarks.* For the structure of the glans of the aedeagus see above (Fig. 55).

***Hyalotephritis planiscutellata* (Becker, 1903)**

*Material.* 3: 11♂♂, 6♀♀.

*Distribution.* Near East south to Ethiopia, Yemen (Merz *et al.*, in press). New for Saudi Arabia.

*Host plant.* *Pluchea dioscoridis* (Asteraceae) (Freidberg & Kugler, 1989).

*Pest status.* Not a pest species.

***Tephritomyia despoliata* (Hering, 1956)**

Figs 56-58

*Acanthiophilus* (*Tephritomyia*) *despoliatus* Hering, 1956: 88. Holotype ♂: «IRAN (Chorassan), Birdjant, 23.VII.-2.VIII.1954, Richter & Schäuuffele», «*Acanthiophilus despoliatus* m. Type, det. M. Hering 1955» (SMNS). Paratype ♂, same data as holotype (SMNS) (examined).

*Material.* 2: 7♂♂, 10♀♀.

*Distribution.* So far only known from Iran. New for Saudi Arabia.

*Host plants.* Unknown. All other species of the genus with known host plants live in flowerheads of *Echinops* spp. (Cardueae, Asteraceae) without causing galls.

*Pest status.* Not a pest species.

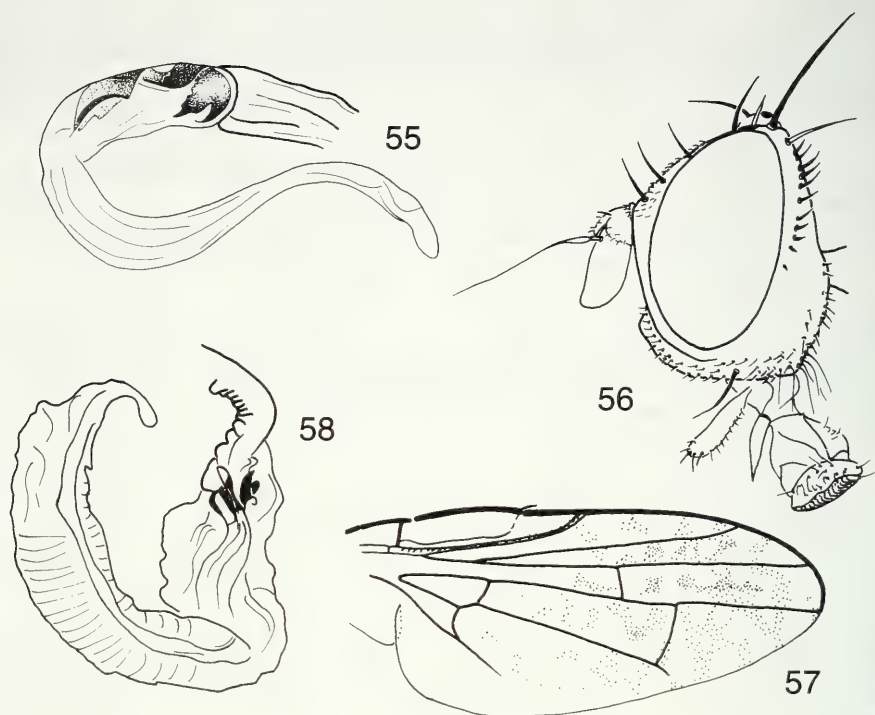
*Remarks.* *Tephritomyia* is a difficult Palaearctic and Afrotropical genus of morphologically similar species and is in need of revision. Based on the original description the specimens from Saudi Arabia resemble *Acanthiophilus despoliatus* Hering, which was described from 3 specimens from Iran (Hering, 1956). The comparison of the holotype and a paratype of the latter and the specimens from Saudi Arabia shows a general resemblance. The differences are:

1. Wing length: The two specimens from Iran have longer wings (4.60-4.81 mm, compared to 3.6-4.2 mm in Saudi Arabian specimens), but the specimens from Saudi Arabia were collected in alcohol and dry mounted, and have the wings usually slightly folded. The real length may be longer.

2. Leg colour: The types from Iran have entirely yellow legs, whereas the colour of the Saudi Arabian population is more variable, with specimens having entirely yellow legs to others with black marks or a black ring in basal third of one to all femora.

*T. despoliatus* is morphologically quite similar to the widely distributed Palaearctic species *Tephritomyia lauta* (Loew) (compare head shape, Fig. 56 with Fig. 133 in Freidberg & Kugler, 1989, and male terminalia, compare Fig. 58 with Fig. 24.12.C in Merz, 1999, for *T. lauta*). The two species differ by the much paler wing pattern without clearly delimited hyaline spots in *T. despoliatus* (Fig. 57). In *T. lauta*, the pattern is stronger with the hyaline spots more regular and entirely surrounded by the dark pattern (see Fig. 24.8.A in Merz, 1999). In general, *T. despoliatus* is much paler, with the scutellum either entirely yellow or only grey at base (usually entirely grey in *T. lauta*). The abdominal tergites have a more extensive yellow pattern (usually almost entirely grey in *T. lauta*), but intermediate specimens occur in both species. The length of the ov scape is more variable in *T. lauta* (as long as preceding 2.5-4 tergites combined, but at most as long as preceding 3 tergites combined in *T. despoliatus*).





FIGS 55-58

*Hyalotephritis complanata* (Munro, 1929, specimen from Abha) (55) and *Tephritomyia despoliata* (Hering, 1956, specimen from Abha) (56-58): 55, 58, male, glans; 56, head; 57, wing.

Hering (1956) considered the shape of the postpedicel as the best discriminating character between *T. despoliatus* and *T. lauta*. The study of numerous specimens of *T. lauta* from Israel, Cyprus and Crete shows, however, that there is no clearcut gap between the two species for this character. It seems that the shape of the postpedicel in the different specimens is the result of the drying process.

At the present state of knowledge we prefer to consider the two populations from Iran and Saudi Arabia as conspecific. Their status should be revised, however, as soon as more specimens become available, and/or biological data about the host plants are known.

***Trupanea amoena* (Frauenfeld, 1857)**

*Material.* 2: 38♂♂, 31♀♀.

*Distribution.* Southern Palaearctic Region, East Africa, Oriental Region, Australia. Recorded from Saudi Arabia by Al-Ahmadi & Salem (1999).

*Host plants.* This is one of the most polyphagous Tephritinae, attacking capitula of species of various Asteraceae (*Achillea*, *Carthamus*, *Ethulia*, *Lactuca*, *Launaea*, *Leontodon*, *Picris*, *Sonchus* and others) (Freidberg & Kugler, 1989; Merz, 1994; Munro, 1964).

*Pest status.* Recorded as minor pest on *Calendula officinalis* (Asteraceae) in India (White & Elson-Harris, 1992).

***Trupanea pseudoamoena* Freidberg, 1974**

*Material.* 2: 2 ♀ ♀.

*Distribution.* Near East. Recorded from Saudi Arabia by Freidberg & Kugler (1989).

*Host plant.* *Pulicaria crispa* (Asteraceae) (Freidberg & Kugler, 1989).

*Pest status.* Not a pest species.

***Trupanea repleta* Bezzi, 1918**

Figs 59-69

*Trypanea aucta* var. *repleta* Bezzi, 1918: 45. Holotype ♂: [ERITREA] «Ghinda, Mochi, VI.16» (handwritten, white paper), «repleta» (in Bezzi's handwriting, white paper), «Holotypus ♂, *Trupanea aucta* var *repleta* Bezzi 1918, desig. B. Merz 2004» (handwritten, red label) (MCSNM) (examined).

*Material.* 2: 10 ♂ ♂, 20 ♀ ♀. Further specimens studied. CAPE VERDE ISLANDS: 3 ♂ ♂, S. Tiago, Lagoa, 15.II.1954, Lindberg; 4 ♂ ♂, 1 ♀, Sol, Terra Boa, 21.I.1954, Lindberg; 1 ♂, Maio, Pedro Vaz, 3.II.1954, Lindberg; 1 ♂, Maio, Morrinho, 3.II.1954, Lindberg; 1 ♂, S. Vicente, Rib. Julião, 9.-11.III.1954, Lindberg; 1 ♂, Nicolau, Rib. Brava, 6.-19.XII.1953, Lindberg (all FMNH). YEMEN: see Merz *et al.* (in press).

*Diagnosis.* Within *Trupanea* this is a typical species of the former *Urelliosoma*, with crescent hyaline apical wing pattern (Figs 60-63) and with a pale brown abdomen in both sexes. No sexual dimorphism in wing pattern; wing with narrow basal cross-band with an obtuse angle on level of M; this band often broken around M; small hyaline spots in r2+3 and r4+5 sometimes present; head with slightly produced vibrissal corner (Fig. 59); glans with typical sclerotized hook (Fig. 67).

*Redescription.* WING LENGTH. Male: 2.5-3.05 mm; female: 2.5-2.85 mm.

**HEAD** (Fig. 59). Mat yellow, upper frons, ocellar triangle and occiput partly thin grey microtrichose; compound eye 1.3-1.5 times as high as long, gena 1/10 as high as eye; frons about as long as wide, anteriorly with few pale setulae; lunule rather high, conspicuous; face slightly concave; vibrissal corner projecting in profile slightly beyond base of antennae; antennae yellow, scape white setulose, pedicel with black setulae; postpedicel dorsally concave, dorso-apically slightly pointed; mouthparts yellow, capitate; palpus not projecting beyond vibrissal corner. Chaetotaxy: frontal setae, anterior orbital seta, ocellar seta and medial vertical seta pale brown, other setae yellow to white; 3 frontal setae, 2 orbital setae, 1 ocellar seta, 1 medial and 1 lateral vertical seta, 1 postocellar seta; row of postocular setae white; no medial postocellar seta.

**THORAX.** Scutum, scutellum and pleura ash-grey microtrichose; ground colour of notopleura, postpronotum and pleura partly yellow; scutum covered with short, white setulae; all setae pale brown, only posterior notopleural seta white; dorsocentral seta almost at level of suture; chaetotaxy as usual in the genus.

**LEGS.** Yellow; foretarsus without modifications or modified setulae in both sexes.

**WING** (Figs 60-63). R4+5 bare on both sides; posterodistal extension of cell bcu indistinct; pattern brown, but basal crossband often paler, almost yellow; no bulla;

basal crossband narrow, stripe-like, sometimes interrupted on one or both sides of obtuse angle on level of M; both crossveins bordered by brown ray; hyaline spot at tip of R2+3 present or absent; small hyaline spots in dark patch of r2+3 and r4+5 sometimes present (Fig. 61); hyaline spot in r4+5 just anterior to DM-Cu always present; at tip of R4+5 sometimes with small dark, isolated spot; brown ray in dm just distal to of R-M reaching CuA1 (Figs 62-63) or reduced (Fig. 61), rarely absent. No sexual dimorphism in wing pattern. Halter and calypter yellow.

**ABDOMEN MALE.** Mat orange-brown, in middle rarely grey microtrichose. Sternite 5 (Fig. 64) concave distally, with 1 lateroapical seta; epandrium yellow, ovoid (Figs 65-66); prenisetae subequal, claw-shaped; glans (Fig. 67) with sclerotized hook dorsally and small sclerotization basally; vesica small.

**ABDOMEN FEMALE.** Oviscape as long as last two tergites of preabdomen combined, black, at base with white setulae; aculeus as in Figs 68-69, apically rounded, without step.

*Distribution.* Cape Verde Islands, Eritrea, Yemen. New for Saudi Arabia.

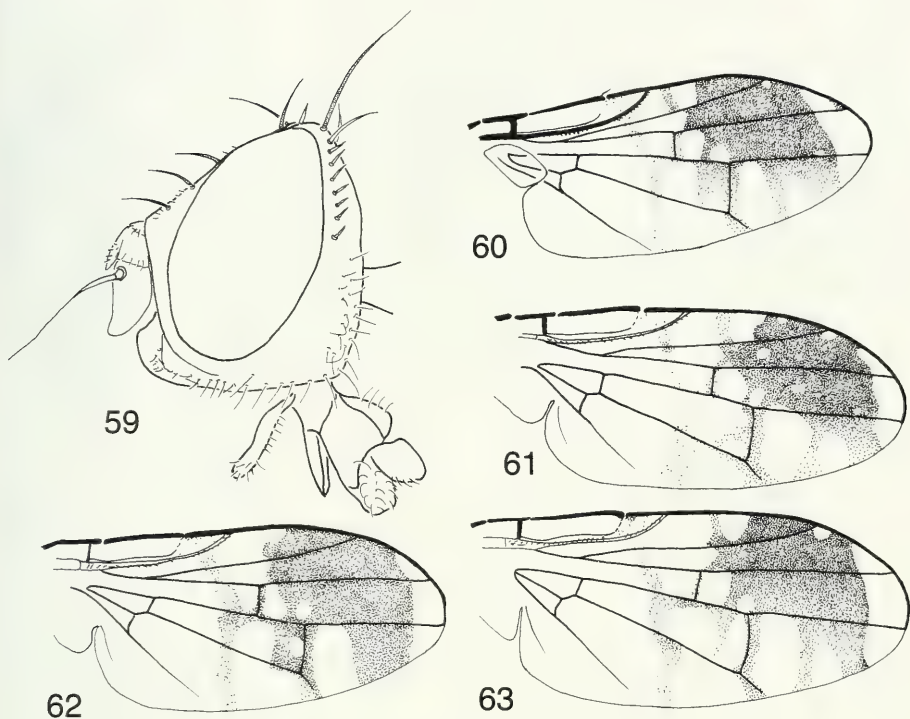
*Host plants.* They are unknown for *T. repleta*. Taking into account the very limited host plant range of species of the group of species formerly placed in the genus *Urelliosoma* which is restricted to *Launaea* (Asteraceae, Cichorioideae) it is assumed that *T. repleta* attacks the same plant genus. According to Kilian (in litt., 17.V.2004) a possible host is *Launaea intybacea*, whose distribution matches the distribution of the fly. This plant forms a monophyletic species group with *Launaea nudicaulis*, which is the only known host plant of *T. pulcherrima*, probably the sister species of *T. repleta* (see below).

*Pest status.* Not a pest species.

*Remarks.* The specimens from Saudi Arabia are superficially very similar to specimens of *Trupanea pulcherrima* (Eflatoun, 1924) from Israel, but they key out as *T. repleta* in Munro (1964). The latter is a very poorly known species. The original description and illustration of Bezzi (1918) are insufficient and misleading because they are based on one male only and compared with an Indian species which belongs to another species group. Frey (1958) reports on the variability of the wing pattern in specimens from the Cape Verde Islands, and Munro (1964) who did not see the holotype, did not add further characters. Judging from the illustration of the wing in Bezzi (1918) it seems reasonable to assume that *T. repleta* belongs to the group of species formerly placed in *Urelliosoma* Hendel, 1927, a genus which was synonymized with *Trupanea* by Merz (1999) and which includes also *T. pulcherrima*. In order to clarify the status of the two taxa, the holotype of *T. aucta* var *repleta* Bezzi and the specimens mentioned by Frey (1958) were studied, as well as numerous specimens of *T. pulcherrima* (see below). It is concluded here that both taxa represent distinct species which differ in morphology, distribution, and probably also in their biology.

### *Trupanea pulcherrima* (Eflatoun, 1924)

*Tephritis pulcherrima* Eflatoun, 1924: 100. Syntypes: 7 ♂♂, 2 ♀♀, EGYPT: Wadi Hoff; 7th Tour, Suez Road; Ezbet-el-Naghl (Plant Protection Department, Ministry of Agriculture, Dokki, Cairo, Egypt; Entomological Society of Egypt, Cairo; for details see Norrbom *et al.*, 1999a) (not examined).



FIGS 59-63

*Trupanea repleta* Bezzi, 1918: 59, head, lateral view; 60, wing male (holotype); 61 wing male (Abha); 62, wing female (Abha); 63, wing male (Abha).

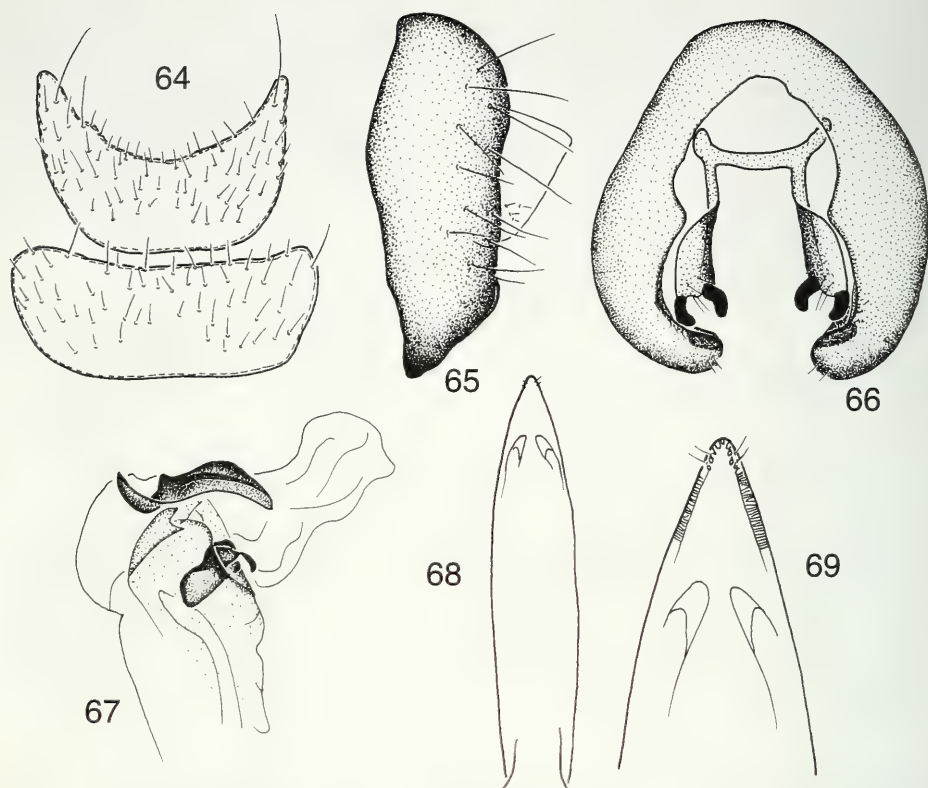
**Material.** ISRAEL: 2♂♂, 1♀, Hameshar, 16.VI.1986, A. Freidberg; 1♀, Mishor Paran, 70 km N Elat, 17.III.1995, Merz; 4♂♂, 2♀♀, Nahal Hiyon, 13.IV.1992, Merz & Freidberg; 1♂, Nahal Zofar, 11.IV.1992, Merz & Freidberg; 1♂, 1♀, Dead Sea, Qalya (= Kallia), 7.VI.1996, Merz & Freidberg (all MHNG). TUNISIA: 1♀, 24 km S Gabès, 33.42N/10.00E, 8.VI.2000, Schmid-Egger; 1♀, 5 km W Douz, 33.29N/8.59E, 21.III.2001, Schmid-Egger (both MHNG).

**Distribution.** Iran, Tunisia, Egypt, and Israel. Recorded from Saudi Arabia by Freidberg & Kugler (1989). This last record should be revised because of its confusion with *T. repleta*.

**Host plants.** *Launaea nudicaulis* (Asteraceae) (Freidberg & Kugler, 1989). The distribution of the plant corresponds perfectly with the known distribution of *T. pulcherrima*.

**Remarks.** The descriptions of Eflatoun (1924), Hendel (1927) and Freidberg & Kugler (1989) are very comprehensive and the species is therefore not redescribed here. Colouration and structure of head, thorax, abdomen and terminalia of both sexes are the same for *T. pulcherrima* and *T. repleta*. Differences between the two species concern the wing pattern. In *T. repleta* the basal dark crossband (from the tip of Sc to the tip of A1+CuA2) is narrow, often paler than the remaining pattern, and in some





FIGS 64-69

*Trupanea repleta* Bezzi, 1918 (64-67, male; 68-69, female, specimens from Abha): 64, abdominal sternites 4 and 5; 65, eandrium, lateral view; 66, same, caudal view; 67, glans; 68, aculeus; 69, tip of aculeus.

specimens broken in the middle. Usually this band is oblique and directed towards R-M until M, forming a very obtuse angle and parallel to DM-Cu until wing margin. In *T. pulcherrima* this basal crossband is much wider and its basal border is almost straight from C to the hind margin of the wing without distinct angle at level of M. Moreover the entire pattern is uniformly brown, or only slightly paler in the stigma.

### *Trupanea* sp. 1

**Material.** 2: 3♂♂, 2♀♀.

**Remarks.** *Trupanea* is one of the largest genera of Tephritidae and is known from all major biogeographical regions, with 40 species known from the Afrotropical Region (Munro, 1964) and about 12 species from the Palearctic Region (Norrbon *et al.*, 1999b). The 5 specimens belong probably to a species close to the *T. stellata* sub-group as defined by Munro (1964). However, they do not fit the description of any species in this monograph nor any other description available to us. Taking into account the large size of the genus, the small differences between species and the unknown variability in many species we are not describing this species here.

*Trupanodesis* sp. 1

*Material.* 2: 1 ♂.

*Remarks.* The genus was proposed by Merz (1999) for *Trupanea aurea* Bezzi, 1924 (type species) and an undescribed species from Kenya based on a cladistic analysis. The specimen from Saudi Arabia may be the same species as the undescribed species from Kenya. However, as only one specimen is available, this identification is tentative.

*Distribution and host plants.* This is an Afrotropical genus with both species assigned to it living in flowerheads of *Vernonia* (Asteraceae, Vernonieae) (Merz, 1999).

## DISCUSSION

In the course of a survey of the insect fauna of the Aseer (= 'Asir') area in southwestern Saudi Arabia 51 species of Tephritidae were found, of which 42 species could be named (Tab. 1). Six of them are new to science, and 9 species could not be identified safely to species level. Previously, 22 species were recorded from this country, and the presence of half of them could be confirmed in this study. For 11 species we could not find specimens in the Malaise traps during this survey. In total, 62 species of Tephritidae are currently known to occur in Saudi Arabia. This diversity matches well with other countries of the Near and Middle East except for Israel which is much better known through the collecting efforts of A. Freidberg in the last 35 years in all parts of the country (Freidberg & Kugler, 1989). No comparative effort has been conducted for other countries in the region, and it is thus likely that their real species number is much higher. For instance, 17 species recorded from the southernmost part of Israel and the Sinai mountains in Egypt have not yet been found in Saudi Arabia, but most of them should also occur in the mountains next to the Gulf of Aqaba in the northwestern part of Saudi Arabia. Examples are *Capparimyia savastani* (Martell), *Euarestella kugleri* Freidberg and *E. pninae* Freidberg, *Goniurellia lacerata* (Becker) and *G. longicauda* Freidberg, *Notomma mutilum* (Bezzi) and *Trupanea desertorum* (Eflatoun).

The present study is interesting from a biogeographical point of view: Over two thirds of the species of the Aseer area are of Afrotropical origin. This means that these species have a predominantly Afrotropical distribution, or most species of the genus are Afrotropical. Four species are typical for desert areas in the Near and Middle East (e. g., *Metasphenisca negeviana*, *Trupanea pseudoamoena*), and only one species, *Ensina sonchi*, is a typical Palaearctic species. Four species are widespread in the Old World (e. g., *Dioxya sororcula*, *Spathulina acroleuca*), and one species, *Bactrocera zonata*, is a recent introduction from the Oriental Region. On the other hand, typical Oriental species are not present in the Aseer area nor elsewhere in Saudi Arabia. Interestingly enough, some genera and tribes which are widespread in the Palaearctic Region are not yet known in Saudi Arabia, such as Terelliini, Myopitini, or the large genus *Tephritis*. They are all known from desert localities in Israel, Jordan and Syria (Freidberg & Kugler, 1989; Korneyev & Dirlbek 2000), and their occurrence in the North of Saudi Arabia may be expected. In contrast, Israel has a higher proportion of Palaearctic species, with only about 20% of Afrotropical elements (Freidberg, 1988).

Although a remarkable diversity of Tephritidae was collected by a Malaise trap it is generally known that traps are not the best collecting method for Tephritidae.

Sweeping over potential host plants and rearing Tephritids from infested plants yield usually a much higher number of species. Consequently, it may be assumed that the real number of species in Saudi Arabia may be doubled by using better collecting techniques and by collecting in the northern, palaearctic part of the country.

It can be seen from Tab. 1 that 10 species recorded from Saudi Arabia are pest species according to White & Elson-Harris (1992) and require special attention in fruit plantations. Only 4 of these species were found in the present survey: *Carpomyia incompleta*, *Bactrocera zonata*, *Dacus frontalis*, and *D. vertebratus*, and all of them only in small number of specimens. No new pest species was discovered. But other pest species attacking Cucurbitaceae, such as *Bactrocera cucurbitae* or *Dacus ciliatus*, should also occur in the Aseer area. Probably this is again a question of the collecting method. Monitoring those species needs specific collecting methods (e. g., traps with cue lure or methyl eugenol for Dacini; see Munro, 1984).

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## ***Proxiandrena* subgen. nov. und Revision der west- und zentralpaläarktischen Arten der *Andrena proxima*-Gruppe (Hymenoptera, Apidae)**

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### ***Proxiandrena* subgen. nov. and revision of the *Andrena proxima* group in the western and central Palaearctic Region (Hymenoptera, Apidae). -**

The former *Andrena proxima* group is revised for the western and central Palaearctic Region. *Proxiandrena* subgen. nov. is described for the here treated species with *Andrena proxima* as type species. *Proxiandrena* includes 5 valid species, which had been treated as subspecies of *Andrena proxima* s. l. before: *Andrena ampla* Warncke in Morocco, Spain, southern France, the western Alps, and – separated from this area – in Central Asia north of Turkmenistan; *Andrena alutacea* Stoeckert with a range from southeast Germany and eastern Switzerland to the eastern Mediterranean area and Turkmenistan; *Andrena aspericollis* Pérez from Algeria; *Andrena bernicla* Warncke from Turkey; *Andrena proxima* (Kirby) from Central Europe and Italy. A key to the species and diagnostic characters are given and distribution of the species is discussed. The female of *A. bernicla* is unknown and its status as a species remains doubtful.

**Keywords:** Apidae - *Andrena proxima* - new subgenus - taxonomy - revision - faunistics - systematics.

## **EINLEITUNG**

*Andrena proxima* (Kirby, 1802) ist eine in Mitteleuropa weitverbreitete und stellenweise häufige Sandbienenart. Stoeckert (1942) beschrieb die sehr ähnliche *alutacea* aus Mittel- und Südosteuropa. Neben morphologischen Unterschieden berief sich Stoeckert dabei hauptsächlich auf die unterschiedliche Flugzeit der beiden Arten. Ihr Status ist seither jedoch umstritten, da *alutacea* in der Folge von verschiedenen Autoren nicht anerkannt wurde (Warncke, verschiedene Arbeiten; Dylewska 1987, Gusenleitner & Schwarz 2002). Erst Schmid-Egger & Scheuchl (1997) führten die Art wieder in ihrem Bestimmungsschlüssel der mitteleuropäischen *Andrena*-Arten auf. Die Autoren wiesen außerdem auf ein drittes Taxon der Artengruppe aus den Westalpen hin, welches sie ebenfalls für eine eigenständige Art hielten.

In Südeuropa sind drei weitere Formen aus der *proxima*-Gruppe beschrieben, nämlich *proxima* ssp. *bernicla* Warncke, 1975 aus der Türkei, *proxima* ssp. *ampla* Warncke, 1967 aus Spanien und *proxima* ssp. *aspericollis* Perez, 1895 aus Algerien. Eine weitere Form, die von Warncke als Unterart ausgezeichnet ist, aber nicht beschrieben wurde, befindet sich in seiner Sammlung im Oberösterreichischen Landesmuseum Linz.

Ziel der vorliegenden Revision ist es, die genannten Formen zu untersuchen und ihren Status abzuklären. So war insbesondere die Frage zu klären, ob die beschriebenen Taxa Unterarten, Arten oder infrasubspezifische Formen sind. Gleichzeitig erwies es sich als notwendig, für die Artengruppe um *Andrena proxima* eine neue Untergattung zu beschreiben, da die bisherige Lösung, die Arten in die Untergattung *Micrandrena* Ashmead, 1988 zu stellen, mehr als unbefriedigend ist. Die Klärung der verwandtschaftlichen Beziehungen innerhalb der untersuchten Artengruppe war nicht möglich, da die sichtbaren Unterscheidungsmerkmale dafür nicht ausreichend sind.

## UNTERSUCHTES MATERIAL

Das untersuchte Material stammt aus den folgenden Sammlungen (mit den im Text verwendeten Abkürzungen):

ETH	Sammlung der Eidgenössischen Technischen Hochschule in Zürich, Schweiz
GRÜ	coll Grünwaldt, in der Zoologischen Staatssammlung München, Deutschland
Kraus	Privatsammlung Dr. M. Kraus, Nürnberg, Deutschland
MHNG	Muséum d'histoire naturelle, Genève, Schweiz
OLL	coll. Oberösterreichisches Landesmuseum Linz (vor allem coll. Warncke), Österreich
ORT	Privatsammlung Sabine Oertli, Zürich, Schweiz
Scheuchl	Privatsammlung Erwin Scheuchl, Velden, Deutschland
SE	Privatsammlung Dr. Christian Schmid-Egger, Herrsching, Deutschland
ZSM	Zoologische Staatssammlung München, Deutschland

Für die Schweiz werden die Kantone gemäss den Autokennzeichen folgendermassen abgekürzt: BE = Bern; GR = Graubünden; TI = Tessin; VS = Wallis.

## ERGEBNISSE

### *PROXIANDRENA* SUBGEN. N.

TYPUSART. *Melitta proxima* Kirby, 1802 (= *Andrena proxima*).

DIAGNOSE UND BESCHREIBUNG: Diagnostische Merkmale sind hervorgehoben:

WEIBCHEN: *Behaarung und Körpergröße*: 9-12 mm. Körperfarbe schwarz, Tarsen manchmal rötlich aufgehellt. Körperbehaarung grau, weißlich oder gelblich, Tergitendbinden schneeweiß, grau oder schwach gelblich. Kopf und Thorax struppig abstehend behaart, Haare im Mittel doppelt so lang wie Scapus.

*Kopf*: Labrum doppelt so breit wie lang, unten seicht ausgerandet. *Clypeus auf gesamten Oberfläche dicht und grob quer gerunzelt*. Gesicht zwischen Ocellen und Clypeus längs gerunzelt, bzw. wabenartig skulpturiert. Foveae schmal, auf Höhe der Fühlereinlenkung etwa 0,28 x so breit wie halbe Gesichtsbreite (Gesichtsbreite ohne Auge gemessen). Fühlerglied IV halb so lang wie Fühlerglied III.

*Thorax*: Mesonotum im vorderen Teil quer runzlig, auf der übrigen Oberfläche grob und dicht punktiert (Punktabstand = 0,5-1 Punktdurchmesser), Punktwahnenräume glänzend. *Mesospleuren mit grob wabenartiger Skulptur*. Oberseite des Prodo-



deum grob netzartig skulpturiert, das dreieckige Mittelfeld ist mehr oder weniger deutlich mit einer feinen Linie von den ansonsten gleich skulpturierten Seitenfeldern abgegrenzt. *Propodeumseitenfelder bedeckt mit sternförmig zusammenlaufenden Runzeln*, die in der Mitte ein Haar tragen. Oberkante und Hinterkante der Seitenfelder mit mittellanger Sammelfranse, die Haare sind kaum gebogen. Hintertibia schlank, mit grauer Sammelfranse. Die Haare auf der Außenseite sind etwa doppelt so lang wie der Durchmesser der Tibia. Flügeladerung dunkelbraun, Flügel leicht graubraun getönt.

*Abdomen*: Tergite spiegelglatt oder fein chagriniert, matt oder glänzend, manchmal mit öligem Schein. Tergite II-IV mit Endbinden, die durchgehend oder breit unterbrochen sind. Endfranse gelblich oder graubraun, von weißen oder gelblichen längeren Haaren überdeckt. Sternitscheiben grob skulpturiert und punktiert, Sternitdepressionen fein skulpturiert. Sternite II-IV mit abstehenden Endbinden (Winkel von ca. 40 Grad).

MÄNNCHEN: *Behaarung und Körpergröße*: 8-11 mm, ansonsten wie Weibchen.

*Kopf*: Labrum quer rechteckig, unten seicht ausgerandet. *Clypeus dicht und grob quer gerunzelt*. Der übrige Kopf grob gerunzelt. Fühlergeißel dunkel oder unten rötlich aufgehellt. Fühlerglied III etwa 1,3x so lang wie Fühlerglied IV.

*Thorax*: Mesonotum vollständig gerunzelt oder punktiert und mit glänzenden Punktzwischenräumen. *Mesopleuren mit grob wabenartiger Skulptur, Propodeum mit sternförmigen Runzeln* (ähnlich wie beim Weibchen).

*Abdomen*: Tergite glänzend, punktiert oder mit feiner Runzelung. Tergite bis auf eine Art mit grauweißen oder gelblichen Endbinden, die unterbrochen oder durchgehend sind. Sternite mit undeutlichen Endfransen, Sternit VIII schmal, am Ende verbreitert, seitlich mit langen Haaren, die länger als der Durchmesser des Sternites sind und sich zum Ende zu verkürzen. *Genital*. Genital von einfachem Bau, Penisvalve sehr schmal, Gonostylus schmal, ohne Besonderheiten.

DISKUSSION: *Andrena proxima* wurde von Stoeckert (1942) in die *minutula*-Gruppe und von Warncke (1968) in die entsprechende Untergattung *Micrandrena* Ashmead, 1899 gestellt. Dylewska (1987) schloß sich dieser Ansicht nicht an, sondern plazierte *proxima* aufgrund der besonderen Skulptur der Mesopleuren in eine eigene Gruppe, die *Andrena proxima*-Gruppe. Dieser Ansicht schließen sich auch Dubitzky & Schönitzer (2001) an und berufen sich dabei vor allem auf die sternförmig zusammenlaufenden Runzeln der Propodeumseiten. Dieses Merkmal betrachten sie als Autapomorphie der Artengruppe. Eine nähere Verwandtschaft sehen die Autoren vor allem zur *labialis* Gruppe (subg. *Holandrena* Pérez 1890). Da sich meine Kenntnisse der Gattung *Andrena* lediglich auf die mitteleuropäischen Arten beziehen, kann ich diesen Fall nicht selbst abschliessend beurteilen, sondern schließe mich dieser Meinung an.

Ich stimme mit Dylweska (1987) und Dubitzky & Schönitzer (2001) darin überein, daß *proxima* und ihre Verwandten eine eigene monophyletische Artengruppe innerhalb der Gattung *Andrena* bilden. Ihre Stellung rechtfertigt die Beschreibung einer eigenen Untergattung: *Proxiandrena* **subgen. n.** Stoeckerts und Warnckes Ansicht, daß *proxima* zur Untergattung *Micrandrena* gehört, kann ich nicht folgen. Die Übereinstimmung ist eher oberflächlicher Natur (schwarze Arten mit grauer Körperbehaarung und teilweise glänzenden, bzw. punktierten Körperoberflächen, weiße Tergitendbinden). Zwei wesentliche Merkmale von *Micrandrena*, die geringe Körpergröße (< 8 mm) und die dem Stigma stark angenährte Cubitalader I finden sich bei



*proxima* nicht. Auf der anderen Seite sind die beiden charakteristischen Merkmale von *proxima*, die typische Skulptur der Mesopleuren und des Propodeums, nirgends bei *Micrandrena* ausgeprägt.

#### BESTIMMUNGSSCHLÜSSEL ZU DEN *ANDRENA*-ARTEN DER UNTERGATTUNG *PROXIANDRENA*

##### Weibchen

- 1 Tergite ohne weiße Endbinden. Verbreitung Algerien . . . . . *aspericollis* Perez
- Tergite mit deutlichen weißen, grauen oder gelblichen Endbinden. Verbreitung: Marokko, Europa, Asien . . . . . 2
- 2 Mindestens Scheiben und Depressionen der Tergite II-III, für Tiere aus Mitteleuropa auch von Tergit IV gleichmäßig gerunzelt und chagriniert, ohne Glanz. Tergite unpunktiert oder bei manchen Tieren Tergite II-IV seitlich punktiert. Tergitendbinde IV durchgehend (nur bei frischen Tieren sichtbar!). Thorax (in lateraler Sicht) mit einer kurzen schwarzen Unterbehaarung zwischen den langen hellen Haaren. Von Süddeutschland, Ostschweiz, Südosteuropa, Türkei bis Zentralasien. In der Türkei auch *bernicla*, die im weiblichen Geschlecht nicht von *alutacea* zu trennen ist . . . . . *alutacea* Stoeckert
- Mindestens die Tergitbeulen und Teile der hinteren Tergite glänzend. Tergite häufig punktiert, mindestens auf Tergit III und IV seitlich. Tergitendbinde IV bei *proxima* auch bei frischen Tieren in der Mitte breit unterbrochen, bei *ampla* können die Tergitbinden durchgehend sein. Mit oder ohne schwarze Unterbehaarung auf dem Thorax . . . . . 3
- 3 Tergitscheiben und Tergitdepressionen fein gerunzelt und mehr oder weniger glänzend, zum Teil mit öligem Schein. Tergitscheibe II-IV ohne deutliche Punktierung. Tergitbeulen spiegelglatt, glänzend. Thorax (in lateraler Sicht) meist ohne kurze schwarze Unterbehaarung, manchmal ist diese schwach ausgebildet. Dreieckiges Mittelfeld des Propodeum undeutlich zu den Seitenfeldern abgegrenzt. Binden gelblich. Kleiner, 9-10 mm. Verbreitung: Europa außer Iberische Halbinsel, fehlt anscheinend in den zentralen und westlichen Alpentälern . . . . . *proxima* (Kirby)
- Tergitdepression spiegelglatt, Tergitscheiben II-IV mit deutlicher Punktierung, die der Tergite III und IV gröber als die von Tergit II. Tergitscheiben zwischen den Punkten ebenfalls spiegelglatt, im basalen Teil mit schwachen Runzeln. Thorax (in lateraler Sicht) zwischen der langen hellen Behaarung mit dichter und kurzer schwarzer Unterbehaarung. Dreieckiges Mittelfeld des Propodeum bei den meisten Tieren mit deutlichen, aber feinem Kiel zu den Seitenfeldern zu abgegrenzt. Binden schneeweiß. Größer, 10-12 mm. Zentrale und westliche Alpen: Aostatal, Südschweiz, Durancetal, Iberische Halbinsel (Verbreitung in Südfrankreich noch unklar), Zentralasien . . . . . *ampla* Warncke

##### Männchen

- 1 Tergite ohne weiße Endbinden. Mesonotum auf der ganzen Fläche grob gerunzelt, dazwischen chagriniert. Verbreitung: Algerien . . . *aspericollis* Perez

- Tergite mit deutlichen weißen, grauen oder gelblichen Endbinden. Tiere aus Marokko: Mesonotum mit glänzenden Punktzwischenräumen. Verbreitung: Marokko, Europa, Asien ..... 2
- 2 Gesicht dunkelbraun behaart. Türkei ..... *bernicla* Warncke
- Gesicht hell behaart ..... 3
- 3 Mesonotum vollständig chagriniert und wabenartig gerunzelt, keine eingestochenen Punkte oder glänzende Punktzwischenräume erkennbar. Tergite I-IV: Basis fein gerunzelt, Mittelteil glänzend mit zerstreuten Mikropunkten, Depression fast punktfrei, im apikalen Teil sehr feine Mikropunkte. Tergitendbinden II-IV in der Mitte breit unterbrochen. Körperbehaarung gelblich. Europa außer Iberische Halbinsel, Zentralasien, fehlt anscheinend in den zentralen und westlichen Alpentälern ..... *proxima* (Kirby)
- Mesonotum mit glänzenden Punktzwischenräumen, die im hinteren Teil 0,5-1 Punktdurchmesser betragen (bei *ampla* aus der Schweiz vereinzelt stärker chagriniert). Tergite I-IV: Basis und Mittelteil glänzend mit deutlich eingestochenen Punkten, die im direkten Vergleich mindestens doppelt so groß wie bei *proxima* sind. Depression unterschiedlich. Tergitendbinden unterschiedlich. Körperbehaarung weißlich. Die beiden folgenden Arten sind sehr ähnlich und ohne zugehörige Weibchen nur aufgrund ihrer geografischen Verbreitung sicher zu trennen ... 4
- 4 Verbreitung: Süddeutschland, Ostschweiz, Südosteuropa, Türkei. Tergite im Mittel weniger dicht punktiert, Punkte im direkten Vergleich kleiner als bei *ampla*. Tergitendbinden III und VI bei frischen Tieren durchgehend ..... *alutacea* Stoeckert
- Verbreitung: Zentrale und westliche Alpen: Aostatal, Südschweiz, Durancetal, Spanien (Verbreitung in Südfrankreich noch unklar, in der Schweiz Überschneidung mit dem Areal von *alutacea*), Zentralasien. Tergitendbinden in der Mitte breit unterbrochen, selten Binde IV durchgehend (bei asiatischen Tieren) ..... *ampla* Warncke

#### VERGLEICHENDE BESCHREIBUNG DER *ANDRENA*-ARTEN DER UNTERGATTUNG *PROXIANDRENA*

Nachfolgend werden die für die Artunterscheidung wichtigen Merkmale beschrieben und die Arten dabei gegenübergestellt. Bei der nachfolgenden Besprechung der Arten wird lediglich eine kurze Diagnose der Arten gegeben.

#### Behaarung des Mesonotum, Weibchen

<i>alutacea</i>	Weißlich, in der Länge unregelmäßig, in der Tendenz etwas kürzer als bei <i>proxima</i> . Auf der ganzen Länge des Tergites mit feiner, kurzer dunkler Unterbehaarung.
<i>ampla</i>	Gelblich, bei spanischen Tieren auch weißlich, die übrigen Merkmale wie bei <i>alutacea</i> .
<i>aspericollis</i>	Gelblich, lang, ähnlich <i>proxima</i> .
<i>proxima</i>	Gelblich, in der Länge gleichmäßig, im Mittel etwas länger als bei <i>alutacea</i> und <i>ampla</i> .

**Tergitskulptur, Weibchen**

- alutacea* / Mitteleuropa Tergite gleichmäßig fein gerunzelt (chagriniert), matt. Tergitbeulen leicht glänzend, ebenfalls gerunzelt. Glanz nimmt auf Tergit IV leicht zu. Auf den Tergitscheiben undeutliche Punkte erkennbar. Tergitdepressionen in der Tendenz schmaler und weniger stark bogenförmig als bei *proxima*, außerdem wirkt der Niveauunterschied zwischen Scheibe und Depression niedriger als bei *proxima*.
- alutacea* / Türkei Die feine Runzelung der Tergite verschwindet nahezu, Tergite wirken glatt. Scheiben und Tergitdepressionen mit identischer Skulptur. Auf den Tergiten I-II ist noch eine feine Chagriniierung erkennbar, die auf den Endtergiten nahezu verschwindet. Tergitscheiben II und IV sehr schwach, klein und zerstreut punktiert.
- ampla* Tergite spiegelglatt und stark glänzend, auf den Tergitscheiben II und III leichte Chagriniierung erkennbar. Tergitscheiben II-IV mit deutlich eingestochener und teilweise grober Punktierung, Punkte im Mittel 2-3 Punktdurchmesser voneinander entfernt. Bei den spanischen Tieren kann die Punktierung weniger stark und die Chagriniierung stärker ausgeprägt sein. An der Tergitpunktierung sind solche Tiere aber immer von *proxima* und *alutacea* zu unterscheiden.
- aspericollis* Tergitskulptur entspricht der von *alutacea*.
- proxima* Tergite chagriniert, mehr oder weniger stark glänzend, besonders auf den hinteren Tergiten. Die Tergitdepressionen stärker glänzend als die Scheiben, Depression IV manchmal spiegelglatt. Tergitbeulen fast immer spiegelglatt.

**Tergitendbinden auf den Tergiten II-IV, Weibchen**

- alutacea* Schneeweiß, anliegend. Sie entspringen etwas oberhalb des Tergitendrandes, so dass sie den Tergitendrand um ihre halbe Länge oder 2/3 ihrer Länge überragen. Binde auf Tergit IV durchgehend, auf Tergit II und III breit unterbrochen. Unterbrechung auf Tergit III entspricht etwa der Breite der Binde (Breite: vom Tergitseitenrand Richtung Tergitmitte), auf Tergit II etwa der doppelten Bindenbreite.
- ampla* Schneeweiss, etwa im Winkel von 30° abstehend (bei den asiatischen Tieren anliegend, und nach hinten gerichtet). Die Binde entspringt etwas tiefer als bei *alutacea*, aber weiter zur Tergitbasis als bei *proxima*. Binde auf Tergit IV schmale (Ozellenbreite) bis breiter (Länge des Fühlergliedes III) unterbrochen, die anderen Binden breit unterbrochen. Bei asiatischen Tieren Binde auf Tergit IV durchgehend.
- aspericollis* Keine Binden vorhanden.
- proxima* Gelblich, etwa im Winkel von 30° abstehend. Die Binde entspringt fast unmittelbar am Tergitendrand. Binde IV breit unterbrochen (etwa um Bindenbreite), die übrigen Binden sehr kurz (etwa ein Viertel der Tergitbreite).

**Skulptur des Mesonotum, Männchen**

- alutacea* Deutlich eingestochen punktiert, mit glänzenden Punktwischräumen, die 0,2-1 Punktdurchmesser betragen. Basal zum Teil auch chagriniert, bzw. ohne erkennbare Punkte.
- ampla* Wie *alutacea*, allerdings mit großer Variationsbreite. Tiere aus dem Aostatal sind sehr deutlich punktiert mit glänzenden Zwischenräumen, bei Tieren aus der Schweiz ist das Mesonotum manchmal vollständig chagriniert, ohne erkennbare Punkte.

<i>aspericollis</i>	Chagriniert, mit körnigen Erhabenheiten oder Runzeln, keine Punkte oder glänzende Flächen erkennbar.
<i>bernicla</i>	Wie <i>aspericollis</i> .
<i>proxima</i>	Wie <i>aspericollis</i> .

### Skulptur der Tergite II-IV (Punktwischenräume bei allen Arten glänzend), Männchen

<i>alutacea</i>	Tergitscheiben fein eingestochen punktiert, Punktdurchmesser ca. 0,3-0,5 x wie Punktdurchmesser auf Mesonotum, Punktabstand 1-2 Punktdurchmesser. Tergitbasis fein quer chagriniert. Tergitdepression mit zerstreuten, sehr feinen Punkten, die vordere Hälfte der Tergitdepression teilweise punktfrei.
<i>ampla</i>	Wie <i>alutacea</i> , Punktdurchmesser im Mittel größer (ca. 0,5-0,8 x Punktdurchmesser auf Mesonotum), meist bis zur Tergitbasis glänzend.
<i>aspericollis</i>	Tergitscheibe mit sehr undeutlichen und kleinen Punkten, basal fein quengerunzelt. Tergitdepression nahezu glatt.
<i>bernicla</i>	Tergitscheiben mit feinen Punkten (in der Größe ähnlich <i>alutacea</i> ), Punktabstände 1-3 Punktdurchmesser, Tergitdepression mit sehr wenigen zerstreuten Punkten.
<i>proxima</i>	Tergitscheiben mit sehr feinen und zerstreuten Punkten, Punktabstände 2-5 Punktdurchmesser, Tergitdepressionen punktlos oder mit vereinzelt sehr feinen Punkten.

### Endbinden Tergite II-V Männchen (kann nur bei frischen Tieren beurteilt werden)

<i>alutacea</i>	Tergit III und IV mit (fast) durchgehender Endbinde. Tergit V mit lockerer Endbinde, die aus langen Haaren besteht. Binden schneeweiß.
<i>ampla</i>	Tergite II-IV mit breit unterbrochenen Binden, Binde auf Tergit IV kann jedoch auch durchgehend sein (bei zentralasiatischen Tieren). Tergit V mit undeutlicher durchgehender Endbinde. Binden schneeweiß, dichter als bei <i>proxima</i> .
<i>aspericollis</i>	Die beiden untersuchten Männchen ohne erkennbare Binden. Dies mag jedoch vielleicht auf den Erhaltungszustand der Tiere zurückzuführen sein.
<i>bernicla</i>	Wie bei <i>proxima</i> , Binden jedoch weiß.
<i>proxima</i>	Tergitendbinden II-IV immer breit unterbrochen (mindestens auf 1/3 der Tergitbreite). Tergit V apikal ohne erkennbare Endbinde. Binden gelblich.

### Körpergröße

	Weibchen	Männchen
<i>alutacea</i>	10-11 mm	9-11 mm
<i>ampla</i>	10-12 mm	9,5-11 mm
<i>aspericollis</i>	11-12 mm	8 mm
<i>bernicla</i>	-	8-9 mm
<i>proxima</i>	9-10 mm	8-10 mm

### Verbreitung

<i>alutacea</i>	südöstliches Deutschland, Ostschweiz bis Südosteuropa, Lettland, Türkei, Iran und Turkmenistan.
<i>ampla</i>	Marokko, Iberische Halbinsel, Frankreich, Südfrankreich, Durancetal; Südschweiz, Italien: Aostatal, Aserbeidschan bis Zentralasien.



<i>aspericollis</i>	Algerien.
<i>bernicla</i>	Türkei (nördliche Hälfte?).
<i>proxima</i>	Mitteleuropa, Großbritannien, Italien, Südosteuropa bis Griechenland.

### *Andrena alutacea* Stoeckert, 1942

*Andrena alutacea* Stoeckert, 1942: 236-252 (Erstbeschreibung ♂ und ♀, Holotypus ♀, Typusfundort: Eining/Donau, ZSM, untersucht) – Pittioni & Schmidt, 1943: 33 (Fauna von Österreich, Bulgarien). – Kocourek, 1966: 69 (Fauna Tschechoslowakei, nur in Mähren) – Schmid-Egger & Scheuchl, 1997 67-68, 142 (Schlüssel für Mitteleuropa, Angaben zur Verbreitung und Phänologie) – Mandery, 2001: 116 (Fauna für Franken, aktuelle Funde).

*Andrena proxima*: Warncke, 1967: 209, 250 (synonym mit *proxima*) – Warncke, 1986: 45 (synonym mit *proxima*) – Westrich, 1984: 23 (synonym mit *proxima*, mit Paratypus verglichen) – Dylewska, 1987: 547 (synonym mit *proxima*) – Schwarz et al., 1996 50 (synonym mit *proxima*: „*A. alutacea* ist entgegen bisweilen geäußerter Vermutungen keine eigene Art“) – Gusenleitner & Schwarz, 2002: 610-611 (Literaturzitate, zu *proxima* gestellt, bzw. als forma von dieser behandelt).

UNTERSUCHTES MATERIAL (PT = Paratypus): **Holotypus**: ♀ mit drei Etiketten: [Eining a.D 24.6.1927 leg. Stoeckert]; [Type]; [*Andrena alutacea* ♀, det. E. Stoeckert] (ZSM). Fundort: Eining an der Donau, Bayern, Deutschland. ASERBEIDSHAN: ♀ 21.6.1957 Nachitschewan, Chrusa, 2000 m. (OLL). BULGARIEN: ♀ Pirin Geb. 1000-1800 m, Banska 25.6.1938, PT (ZSM). 2 ♂ 2 ♀ 30.5.1989 Slancev Briag (OLL). DEUTSCHLAND: Bayern: 2 ♀ 24.06.1932 Eining (1 ♀ PT); ♀ 24.6.1946 Markt Schwaben (GRÜ); 2 ♀ 6.8.1933, 27.7.1933 Pappenheim, PT; ♀ 21.6.1883 Allach (ZSM); Eining 1.7.1938 (PT); ♀ 3.8.97 Ergersheim, Eschenau, Weinbergbrache, *Daucus carota* (Kraus); ♀ 17.7.2004 Altmühltal, 12 km NEE Eichstätt, Gundoldinger Heide (SE), Thüringen: ♀ 20.6.98 Kyffhäuser/Auleben/Solberg, Kalkmagerrasen auf *Achillea* sp; 1 ♀ 23.6.01 Wanderslebener Gleiche b. Gotha, *Apiaceae* gestreift; ♂ 20.6.98 Kyffhäuser/Badra/Feldrain, *Apiaceae* gestreift (Burger, die beiden letzten Tiere det. Burger); Baden Württemberg: ♀ 2.7.1995 Baar/Südostschwarzwald, 2 km N Geisingen, NSG Klause; ♂ 10.6.1996 Hegau, Singen, Hohentwiel (SE). FÜRSTENTUM LIECHTENSTEIN: ♀ 13.6.1997 Balzers, Elltal, ein frisches Tier, zusammen mit einer abgeflogenen *proxima* (ETH). GRIECHENLAND: ♀ 9.05.1973 Mistras; ♀ 29.06.1970 Vytina; 13.6.1956 Olymp, Prioni, 1000 m; ♀ 19.05.1973 Mistria; Mazedonia, Treskaschlucht; ♀ 8.6.1973 Lehau (GRÜ). IRAN: ♀ 20.5.1975 Kermanshahan, 80 km W Kermanshah, Paweh (GRÜ). ITALIEN: 16 ♀ 23.7.-3.8.1933; 19.8.1926 Rovereto; ♀ 25.8.1913 Ritten (Südtirol) (ETH); 2 ♀ 16.7.1925 Bozen, PT; bei Bozen, leg Kohl (MHNG). KROATIEN: 2 ♀ 19.7.1971, 2.8.1972 Istria, Ucka (GRÜ). LETTLAND (Lativa): ♀ 9.08.1931 Meiten (GRÜ). MACEDONIEN: ♀ Cakor-Pass 1969 (ZSM). ÖSTERREICH: ♀ 26.6.1976 Dürnstein, Wachau (GRÜ), 4 ♀ 22.7.1920 Innsbruck (PT, ZSM); 2 ♀ 24.7.1998 Burgenland, Mühlgraben; ♀ 24.7.1998 Burgenland, Oberdrosen-Bergen; ♀ 28.7.1999 Tanka; ♀ 27.7.1996 Steiermark, Katzelsdorf; ♀ 28.7.1996 Steiermark, Reith bei Hartmannsdorf; ♀ 9.7.1998 Tirol, Igls S. Innsbruck; ♀ 13.7.1991 Oberösterreich, St. Georgen/Gusen (OLL). SCHWEIZ: 2 ♀ 26.7.1926 GR, Sent; ♀ 31.7.-3.8. GR, Brusio; 4 ♀ 23.7.1997, 8.8.1997 GR, Haldenstein, Böfel; ♀ Juli 1915 TI, Lugano, Maroggia, PT (ZSM); ♀ 29.7.1999 TI, Indemini, Paese (ETH) – 3 ♀ 1 ♂ TI, Valle Maggia, Lodano, 340 m, an *Anthriscus*; ♀ 1 TI, Valle Maggia, Gordevivo, 310 m (SE). TÜRKEI: ♀ 8.8.1982 Pr. Karkari, Sai Dag, Shagulut, SW Yülsekova 1700 m; ♀ 12.06.1978 Konya, Sille, ♀ 31.5.1959 Amasya, ♀ 12.6.1976 Mus, ♀ 4.6.1972 Gürün, ♀ 20.05.1975 Karakurt, Arastal (GRÜ), ♀ 5.6.1945 Gürün; ♀ 12.6.1978 Konya; ♀ 31.5.1959 Amasya, ♀ 12.6.1976 Mut, ♀ 22.5.1975 Karakurt, Arastal; 3 ♀ Horosan, Arastal; 3 ♀ 1.6.1980 35 km SW Hakkari, ♂ Kars, 20 km W Karakurt 1600 mNN, ♂ 29.5.1980 Agri, 20 km N Patnos, ♂ Nevsehir, Ürgüp 21.8.1971 (OLL). TURKMENISTAN: 5 ♀ 16.5.1975 Bacharden (GRÜ).

DIAGNOSE: *Weibchen*: *Andrena alutacea* ist anhand der gleichförmigen Tergitchagrinierung, den matten Tergiten, der schwarzen Unterbehaarung auf dem Mesonotum und der durchgehenden Tergitendbinde IV von den verwandten Arten zu unterscheiden. *Männchen*: Das Männchen ist im direkten Vergleich kaum von *ampla* zu trennen. Von den anderen Arten läßt sich *alutacea* anhand der glänzenden Punktzwischenräume auf dem Mesonotum und der weißlichen Körperbehaarung sowie den – bei frischen Tieren – durchgehenden hinteren Tergitendbinden abtrennen.

In Mitteleuropa läßt sich *alutacea* ebenfalls anhand der späten Flugzeit von *proxima* abgrenzen. Männchen treten in der Regel ab Mitte Juni, Weibchen ab Anfang Juli auf. Um diese Zeit gibt es praktisch keine frischen *proxima* mehr.

VARIATION: Weibchen aus der Türkei weisen teilweise eine viel schwächer ausgeprägte Tergitchagrinierung auf als die mitteleuropäischen Tiere. Sie erscheinen dadurch stärker glänzend und sehr viel feiner skulpturiert. Allerdings ist die Variationsbreite bei türkischen Tieren relativ hoch. Diese Merkmalsausprägung ist auch bei einzelnen Tieren aus Griechenland zu beobachten, so dass hier wahrscheinlich eine kontinuierliche Merkmalsverschiebung stattfindet, die der Variationsbreite der Art zuzurechnen ist. Allerdings sind Weibchen aus Turkmenistan wiederum stärker chagrinieren und weisen außerdem zum Teil eine relativ grobe, fast schon körnige Tergitpunktierung auf den Tergiten II-IV seitlich auf.

DISKUSSION: *Andrena alutacea* wurde von Stoeckert (1942) unter besonderem Hinweis auf die unterschiedliche Flugzeit von *proxima* abgetrennt und als eigene Art beschrieben. Dennoch zog Warncke (1967) die Art ohne jede Begründung ein, weitere Autoren folgten ihm (Dylewska, 1987; Gusenleitner & Schwarz, 2002). Erst Schmid-Egger & Scheuchl (1997) betrachteten *alutacea* mit Hinweis auf die Stoeckertsche Beschreibung und aktuellem Material wieder als selbständige Art.

Eine genaue Prüfung des vorliegenden Materials zeigt, daß sich alle Weibchen, die in Mitteleuropa im Juli und August gefangen wurden, auch morphologisch gut von Tieren unterscheiden, die aus dem Mai und Juni stammen. Das bestätigt meiner Meinung nach die Ansicht von Stoeckert, daß *alutacea* eine valide Art ist. Die Unterscheidungsschwierigkeiten zu *proxima* liegen im Bereich dessen, was bei vielen ‚schwierigen‘ *Andrena* Artengruppen (z. B. *Micrandrena*) üblich ist. Probleme können bei abgeflogenen Tieren in Griechenland auftreten, da dort die Variation von *alutacea* beträchtlich zunimmt.

Auch wenn man die bestehende Ähnlichkeit der beiden Arten in Betracht zieht, würde eine Synonymisierung von *alutacea* mit *proxima* die unterschiedliche Phänologie keinesfalls auf befriedigende Weise erklären. Für eine partielle zweite Generation ist der zeitliche Abstand beider Taxa sehr kurz (sie überlappen sich in der Flugzeit um 1-2 Wochen), außerdem müssten dann beispielsweise im wärmebegünstigten und gut besammelten Baden-Württemberg mehr Tiere von *alutacea* auftreten, was aber nicht der Fall ist (eigene Beobachtung, Doczkal mündl.). Daher erscheint das Konzept zweier valider Arten die wahrscheinlichere Lösung für den vorliegenden Fall.

Anders verhält sich die Situation in Südosteuropa und vor allem in der Türkei. Während in Griechenland *alutacea* etwas später als *proxima* fliegt, wurden alle *alutacea* aus der Türkei, aber auch in Südosteuropa, jeweils im Mai und Juni gefangen (aus der Türkei liegen keine Tiere vor, die *proxima* entsprechen). Einzige Ausnahme

bilden ein Männchen und ein Weibchen aus der Türkei, die aus dem August stammen. Das Männchen aus Ürgüp besitzt eine sehr weitläufige Mesonotumpunktierung, die viel weiter als bei allen anderen Männchen ist (Punktabstände zum Teil mehrere Punktdurchmesser groß). Das Weibchen aus der Provinz Hakkari ist völlig frisch, besitzt eine vollständige Endbinde auf Tergit IV und hat eine insgesamt etwas kürzere und wie geschoren wirkende Körperbehaarung. Ansonsten stimmt es vollständig mit *alutacea* überein. Ob hier eine partielle zweite Generation vorliegt oder sich hinter *alutacea* noch weitere Arten verbergen, muss derzeit offen bleiben.

**VERBREITUNG:** *Andrena alutacea* ist von Mitteleuropa über Südosteuropa bis in die Türkei, den Iran und Turkmenistan verbreitet. In Deutschland kommt sie in Bayern und dem Osten von Baden-Württemberg vor, die meisten Funde stammen dabei aus dem Einzugsbereich der Donau. Ein Einzelfund stammt aus dem südlichen Rheintal (Grißheim; Stoeckert, 1942). Außerdem liegen verschiedene Funde aus Thüringen vor. In der Schweiz ist *alutacea* im Tessin sehr häufig, weitere Funden stammen aus der Ostschweiz (Graubünden) und aus Liechtenstein. Der nördlichste Nachweis stammt aus Lettland. Das Verbreitungsgebiet von *alutacea* überschneidet sich in weiten Teilen mit *proxima*, an mehreren Orten konnten beide Arten sogar zusammen gefangen werden.

Stoeckert (1942) meldet sie aus Deutschland: Bayern; Thüringen: Jena, Erfurt; Baden-Württemberg: Grißheim in Südbaden. Österreich: viele Funde. Polen: Krakau, Lemberg (Galizien). Schweiz: Lugano. Italien: Bozen, Ligurische Alpen, Turin, Trient, Fiume. Kroatien. Rumänien: Szankesd (Siebenbürgen). Bulgarien. Griechenland: Parnass. Georgien: Kaukasus, Borsholm bei Tiflis (dieser letzte Fund bezieht sich höchstwahrscheinlich auf *bernicla*).

**ÖKOLOGIE:** Nach bisherigen Erkenntnissen ist *alutacea* wie ihre Schwesterart *proxima* oligolektisch auf Doldenblütler spezialisiert (Westrich 1989, der die Oligolektie von *proxima* feststellte, trennt nicht zwischen den beiden Taxa). *Andrena alutacea* besiedelt in Deutschland vielfach trockenwarme Magerwiesen. Im Tessin (Schweiz) fing ich die Art auf einer typischen ‚Fettwiese‘ auf *Anthriscus sylvestris* und im Altmühltal (Bayern) am Rande einer Wachholderheide auf *Daucus carota*. Aufgrund der wenigen Funde und der Spezialisierung auf trockenwarme Offenstandorte müßte die Art in Deutschland in den betreffenden Bundesländern in die Rote Liste aufgenommen werden.

### ***Andrena ampla* Warncke, 1967, stat. nov.**

*Andrena proxima* ssp. *ampla* Warncke, 1967: 229, 250: Erstbeschreibung ♂ und ♀, Holotypus ♂; Typenfundort: Spanien, Alberche, OLL, untersucht. – Warncke, 1974a: 11 (Fauna Marokko) – Warncke, 1976: 151: (Fauna Iberien) – Erlandsson, 1979: 125 (Fauna Spanien) – Gusenleitner & Schwarz, 2002: 611-612 (Katalog, S. 1145 Verbreitungskarte von *ampla*).

**UNTERSUCHTES MATERIAL:** **Holotypus:** ♀ mit drei Etiketten: [Alberche V 1909 Arias], [*Andrena proxima* ssp. *ampla* War. det. Dr. Warncke], mit rotem Karton: [Holotype], in coll. OLL. **ASERBEIDSHAN:** ♀ 21.6.1957 Nachitachawan, Chrusa (GRÜ). **FRANKREICH:** ♀ 29.6.1978 Provence, Mt. de Lure, Cruis, ca. 500 m (GRÜ); 4 ♀ 23.8.1998 Ht. Alpes, Aiguilles, le Lombard 1800 m; 12 ♀ 6.6.1997 Ht. Alpes, 18 km S Briancon, Gouffre 900 m, ♀ 6.6.1997 Ht. Alpes, 6 km SW Briancon, Prelles 1200 m (CS). **ITALIEN:** Westalpen, Valle d'Aosta: 22 ♀ 8 ♂ 7.7.1995; 2 ♀ 16.7.1995; 2 ♀ 19 ♂ 27.6.1996, 4 ♀ 2.8.1997 Cognetal, Lillaz, 1700-1800 m, an *Lasiopitium* aff. *siler* L.; ♂ 16.5.1996, St. Pierre 8000 m; 1 ♀ 10 km E Aosta, Trois Villes,



1400 m NN, 16.5.1998 (CS). KASACHSTAN: ♀ 16.6.79 Alma Ata, Alataugeb. 1900m (Kraus) - Axaj bei Alma Ata, 19.6.1981 (OLL) (Etikettiert als *Andrena kocourea* ssp. n., det Warncke Paratypus]. KIRGISIEN: 9 ♀ 15.8.1998 Alaj, G.K. Gultscha Tal, Ak-Bosogo (GRÜ) – 2 ♂ 1 ♀ 7.6.1998 Sandalach-Gebirge, Kain-Su Schlucht. 2000 m NN (Scheuchl). MAROKKO: ♀ 13.5.1965 Azrou (*proxima* det Warncke) (OLL). SCHWEIZ: ♀ 29-31.7.1933 GR, Braggio-S-Marina, Calanca, 1000-1600 m leg. Nadig; ♀ 24.6.1934 GR, Rabijs; ♀ 24.6.1885 VS, Sierre; ♂ 19.8.1943 VS, Follatères; ♀ 26.7.1991 VS, Visperterminen 1380 m; ♀ 1.6.1991 VS, Hohtenn; (ETH) – 65 ♀ 47 ♀, Fangjahre 2001-2002 VS, Erschmatt: Undere Chastler, 1210 m; Oberu Castler 1270 m; Oberi Zaig 1450 m; Chritzmatte 1220 m; Rossuwald 1370 m; Rüemetschbodü 1530 m; Chritzmatte 1120 m, Ritin 1190 m; Platten 890 m, ♂ 15.5-2.6., ♀ 16.5.-27.6. (ORT) – ♀ 21.6.1998 VS, Jeizinen 1500 mNN, felsige Bergwiese (Burger, Herrman); 4 ♀, VS: Sierre, Martigny, St. Luc, Niouc, alle vor 1900 (MHNG). SPANIEN: ♀ Sierra Guadarrama, Dusmet; ♂ Alberche V 1909 (leg) Arias; Montarco (leg) Dusmet, alles Paratypen det. Warncke (OLL) - ♀ Villaviciosa, ♀ 2 ♂ Escorial (alle det K. Warncke als *proxima* ssp. *ampla*), ♀ 11.7.1977 Pr. Guadalajara, Tierzo bei Molina, 1100 m; ♀ 10.7.1975 Malaga, Ronda (GRÜ). TADSCHIKISTAN: ♀ Dusambe, 40 km vych. Javros, 24.6.1981 (OLL) (Etikettiert als *Andrena kocourea* ssp. n., det Warncke Holotypus].

DIAGNOSE: *Andrena ampla* ist im weiblichen Geschlecht wie folgt charakterisiert: Tergite überwiegend spiegelglatt, Tergitscheiben II-IV deutlich und grob punktiert, Punkte gleichmäßig über die Tergitscheibe verteilt. Mit *alutacea* teilt die Art die schwarze kurze Unterbehaarung des Mesonotums. *Andrena ampla* ist durchschnittlich 1 Millimeter länger als *alutacea* (11-12 mm). *Andrena alutacea* Weibchen aus Turkmenistan, die auf den hinteren Tergiten seitlich ebenfalls grob punktiert sind, unterscheiden sich auch hier durch die feine Chagrinierung auf den Tergiten. Die Männchen sind sehr ähnlich wie *alutacea*. Von dieser unterscheiden sie sich durch eine geringfügig dichtere und stärkere Tergitpunktierung sowie Tergitendbinden, die auf den Tergiten III und IV in fast allen Fällen unterbrochen sind (bei *alutacea* durchgehend). *Andrena proxima* läßt sich im männlichen Geschlecht leicht aufgrund des chagrinierten Mesonotums und der nur sehr fein und zerstreut punktierten Tergite unterscheiden.

VARIABILITÄT: Die Tiere aus Zentralasien stimmen mit den europäischen Individuen fast vollkommen überein. Die Tergitendbinden sind bei zwei vollständig erhaltenen Weibchen nach hinten gerichtet und anliegend, während sie bei den europäischen Individuen abstehend und nach außen gerichtet sind. Die Tergitendbinde IV ist bei den asiatischen Tieren durchgehend, während sie bei den europäischen Individuen fast immer unterbrochen ist. Außerdem ist die dichte Tergitpunktierung bei einigen der asiatischen Weibchen körnig-dicht, die Punkte sind nur von schräg hinten zu erkennen.

DISKUSSION: *Andrena ampla* wurde von Warncke als Unterart zu *proxima* von der iberischen Halbinsel beschrieben. Laut seiner Verbreitungskarte (publiziert in Gusenleitner & Schwarz, 2002) stellen die Pyrenäen die Verbreitungsgrenze zwischen der ssp. *ampla* und der ssp. *proxima* dar. Durch die aktuellen Funde von *ampla* in den Alpen wird diese Einteilung hinfällig. Außerdem ist das Taxon von den beiden Arten *alutacea* und *proxima* morphologisch gut unterschieden. In der Flugzeit liegt *ampla* etwa zwischen *proxima* und *alutacea*. Somit halte ich seinen Status als Unterart zu *proxima* für unwahrscheinlich und betrachte *ampla* als valide Art.

*Andrena ampla* ist außerhalb der iberischen Halbinsel nur aus den trockenwarmen großen Binnentälern der Süd- und Südwestalpen nachgewiesen (Wallis, Graubünden, Tessin, Aostatal, Durancetal, bei Genf). Weiterhin liegt ein Fund aus der südlichen Provence vor. Es ist zu vermuten, dass die Art in Südfrankreich weiter verbreitet ist. Wie sie sich dort zu *proxima* abgrenzt, ist noch unbekannt.



In der Schweiz überlappen sich die Areale der drei mitteleuropäischen Arten der Untergattung *Proxiandrena*. Allerdings sind auch hier Unterschiede in der Verbreitung feststellbar. So ist das Wallis (wie das unmittelbar südlich daran angrenzende italienische Aostatal) nach den bisherigen Daten nur von *ampla* besiedelt. Diese dringt jedoch auch noch weiter nach Südosten bis Graubünden und dem Tessin vor und findet sich auch in der Umgebung von Genf. *Andrena alutacea* besiedelt vor allem die Ostschweiz, bzw. Lichtenstein, ihr Verbreitungsgebiet erstreckt sich dabei vom Rheintal bis ins Tessin. *Andrena proxima* hingegen ist vor allem auf die Nordschweiz beschränkt, kommt aber stellenweise auch in den südlichen Landesteilen vor.

Eine ähnliche Verbreitung wie *ampla* weist *Andrena afrensis* Warncke, 1967, auf, die in Spanien, dem Wallis (Westrich *et al.*, 1997) und im Aostatal (Schmid-Egger, unpubl.) vorkommt. Die Schwesterart von *afrensis*, *Andrena agillissima* Scopoli 1770, die in Mitteleuropa weit verbreitet ist, scheint zumindest im Wallis zu fehlen, während im Aostatal beide Arten zum Teil syntop fliegen.

Interessant ist weiterhin das Vorkommen von *ampla* in West- und Zentralasien, welches auf ein disjunktes Areal hinweist. Das Verbreitungsgebiet überschneidet sich dort nach den vorliegenden Daten weder mit *proxima* noch mit *alutacea*. Die asiatischen Tiere sind geringfügig von den europäischen unterschieden (runzelig dichte Punktierung auf den Tergiten III und IV lateral, durchgehende Endbinde auf Tergit IV), allerdings rechtfertigen diese Unterschiede keine Abtrennung der östlichen Populationen als Subspecies.

**ÖKOLOGIE:** Im Aostatal wurde *ampla* auf trockenen, blütenpflanzenreichen, süd-exponierten Almwiesen in Höhen zwischen 1700 und 1800 m ü. NN angetroffen. Die Art flog dort zahlreich auf *Laserpitium* cf. *siler* und war unter anderem vergesellschaftet mit *Osmia dalmatica* Morawitz (Apidae), *Bembix tarsata* Latreille (Crabronidae) oder *Parnassius apollo* Linné (Lepidoptera). Im Durancetal flog sie in 800-1000 m ü. NN an Wegrändern und auf Wiesen mit magerer, trockenheitsliebender Vegetation. Im Wallis konnte Sabine Oertli die Art ebenfalls in Anzahl auf südexponierten mageren Wiesen und Weiden antreffen. Sie stellte Blütenbesuch auf *Anthriscus sylvestris*, in geringerem Mass auch auf *Heracleum sphondylium* und *Pimpinella major* fest. Auf den Weiden blühte *Laserpitium siler* (Oertli in litt.). Somit scheint die Art wie auch *proxima* oligolektisch an Doldenblütlern (Apiaceae) gebunden zu sein.

**VERBREITUNG:** Disjunkt in Europa und Asien. *Europa*: Südliche Schweiz; Norditalien: Aostatal; Südwestfrankreich: oberes Durancetal; Südfrankreich: Provence; Spanien, Marokko. Nach Warncke (1976) in Spanien und Portugal weit verbreitet. *Asien*: Aserbeidschan, Kasachstan, Kirgisien, Tadschikistan.

### ***Andrena aspericollis* Pérez, 1895, stat. rest.**

*Andrena aspericollis* Pérez 1895: 37 (Beschreibung ♀, ♂, keinen Holotypus festgelegt) - Paralectotypus untersucht.

*Andrena proxima* ssp. *aspericollis*: Warncke 1967: 183, 252 (Lectotypus ♀ festgelegt, Teniet, Algerien, coll. Pérez/Paris, stat. nov.) – Warncke 1974a: 11 (Fauna Algerien, Flugzeit Mai bis Juni) – Gusenleitner & Schwarz 2002: 610-611, 1145 (Katalog).

**UNTERSUCHTES MATERIAL:** ALGERIEN: ♀ mit unleserlichem Etikett, 2 ♂ mit gedrucktem Etikett ‚Algerien‘, alle det Warncke als ‚*proxima* ssp. *aspericollis*‘, das ♀ zusätzlich mit einem roten Etikett ‚Paratype‘ (OLL) – ♀ mit unleserlichem Etikett und verschiedenen

Etiketten: Rosa mit schwarzem Rand [Cotypus], [*Andrena aspericollis* det. E. Stoeckert]. [*Andrena proxima* det K. Warncke] (ZSM).

DIAGNOSE: *Andrena aspericollis* ist laut Warncke (1967) dunkler gefärbt als *proxima* und besitzt keine Binden auf den Tergiten. Die Art ist in ihrer Verbreitung auf Algerien beschränkt. Die Weibchen sind auf den Tergiten sehr gleichförmig und fein chagriniert und zerstreut punktiert, das Mesonotum weist eine dichte grobe Punktierung mit kleinen, glänzenden Punktzwischenräumen auf (*ampla* mit glänzenden und auf dem Mesonotum größeren Punktzwischenräumen). Die Männchen besitzen wie *proxima* ein durchgehend chagriniertes Mesonotum und unterscheiden sich dadurch von der ebenfalls in Nordafrika vorkommenden *ampla*, deren Punktzwischenräume auf dem Mesonotum glänzen.

DISKUSSION: Ich konnte nur zwei mangelhaft etikettierte Pärchen untersuchen, die vermutlich alle aus Algerien stammen und wahrscheinlich über 100 Jahre alt sind. Alle diese Tiere sind ohne Tergitbinden. Ob das von Pérez und Warncke beschriebene Hauptmerkmal der Art, die fehlenden Tergitbinden, auf den schlechten Erhaltungszustand der Tiere zurückzuführen oder natürlich ist, kann ich nicht beurteilen. Da sich die Art aber skulpturell sowohl von *ampla* als auch von den europäischen Arten unterscheidet, habe ich keine Zweifel, daß es sich hier um eine eigene Art handelt. Somit stelle ich den ehemaligen Status von *aspericollis* als eigene Art wieder her: *Andrena aspericollis* **stat. rest.**

VERBREITUNG: Algerien.

***Andrena bernicla* Warncke, 1974, stat. nov.**

*Andrena proxima* ssp. *bernicla* Warncke 1974b: 96. Auflistung. – Warncke 1975: 50 (Teil B der Arbeit von 1974): Beschreibung ♂, Holotypus ♂: Türkei, Ankara. (OLL) - Holotypus untersucht, dieser stammt nicht wie bei Warncke 1975 angegeben von Ankara, sondern von Serefikochisar. Allerdings liegen Paratypen von Ankara vor.

*Andrena alutacea*: Stoeckert 1942: 236 ff. Ein Männchen mit schwarzer Gesichtsbehaarung aus Tiflis/Georgien, bezieht sich höchstwahrscheinlich auf *bernicla*.

UNTERSUCHTES MATERIAL. **Holotypus:** ♂ [TR Serefikochisar 17.5.1970 leg. Warncke] [*Andrena proxima* ssp. *bernicla* War. det. Dr. Warncke ]; rotes Etikett [Holotypus] (OLL). TÜRKEI. ♂ 2 ♀ 21.5.1972 Ankara leg. Warncke (alle Paratypen, det Warncke, OLL). Die Weibchen unterscheiden sich nicht von *alutacea* und werden zu dieser gerechnet.

DIAGNOSE: Die Männchen unterscheiden sich von allen anderen Arten der Untergattung durch die schwarzbraune Gesichtsbehaarung (bei den übrigen Arten hell). Das Mesonotum ist ähnlich wie bei *proxima* skulpturiert. Das Weibchen ist nicht bekannt, bzw. läßt sich nicht von *alutacea* unterscheiden.

DISKUSSION: Warncke (1974b) basiert die Beschreibung seiner Unterart *bernicla* auf die schwarze Gesichtsbehaarung des Männchen, die laut dem Autor allerdings nur in der ersten Generation vorkommen soll. Weiterhin ging Warncke in einer Verbreitungskarte (publiziert in Gusenleitner & Schwarz 2002) davon aus, daß in der Türkei nur ein Taxon aus der *proxima*-Gruppe vorkommt, nämlich die ssp. *bernicla*. Wie das vorliegende Material zeigt, ist die Hypothese einer ersten dunkelgefärbten Generation jedoch nicht zu halten, da ich verschiedene türkische Männchen mit heller Gesichtsbehaarung untersuchen konnte, die wie *bernicla* ebenfalls im Mai gefangen wurden (zum Teil von Warncke selbst gesammelt). Da sich diese auch skulpturell von

*bernicla* unterscheiden, gehe ich vielmehr davon aus, daß in der Türkei mindestens zwei Taxa aus der *proxima*-Gruppe, nämlich *alutacea* und *bernicla*, nebeneinander vorkommen. *Andrena proxima* wurde bisher in der Türkei nicht nachgewiesen.

Allerdings ist die Situation um die beiden Taxa damit noch längst nicht befriedigend gelöst. In der coll. Warncke (OLL) befinden sich zwei Weibchen von Ankara, bzw. Sille bei Konya, die Warncke als *bernicla*-Paratypen auszeichnete (ohne daß diese in der Literatur Erwähnung fanden). Beide Tiere - ein Weibchen wurde zeitgleich und am selben Ort mit dem männlichen Paratypus gefangen - sind völlig identisch mit *alutacea*-Weibchen aus Mitteleuropa und aus der übrigen Türkei. Entweder lassen sich die beiden Taxa im weiblichen Geschlecht nicht unterscheiden oder das Weibchen von *bernicla* ist noch unbekannt.

Ein weiteres Problem besteht außerdem bei den Männchen. Stoeckert (1942) erwähnt in der Originalbeschreibung von *alutacea*, daß die meisten Männchen gemischte schwarze und weiße Gesichtshaare mit Übergängen zu ganz weiß oder ganz schwarz besitzen sollen. Im von mir selbst untersuchten Material gab es nur entweder weiße oder schwarz gefärbte Tiere. Ich konnte keine einzige Mischform finden. Es bleibt offen, von wo Stoeckert solche Männchen untersucht hat, da er keine expliziten Fundortangaben dafür macht. Insgesamt basiert er die Beschreibung von *alutacea* auf nur 7 Männchen und über 80 Weibchen, was einen Hinweis auf die Seltenheit der Männchen gibt. Stoeckert erwähnt jedoch ausdrücklich ein Männchen aus Tiflis/Georgien mit vollständig dunkler Gesichtsbehaarung, was höchstwahrscheinlich eine *bernicla* ist.

Vorerst schließe ich aufgrund der morphologischen Unterschiede zwischen beiden Taxa und dem zeitlich übereinstimmenden Auftreten aus, daß *bernicla* eine schwarz gefärbte Form von *alutacea* ist und betrachte das Taxon als eigenständige Art: *Andrena bernicla* **stat. nov.** Die Betrachtung des Taxon als Form von *alutacea* wäre nicht plausibel, da mir solche lokalen Formen bei *Andrena* nicht bekannt sind. Die Gesichtsbehaarung ist vielmehr zumindest bei den mitteleuropäischen Arten ein konstantes Artmerkmal. Um eine partielle erste Generation von *alutacea* kann es sich auch nicht handeln, da eine solche eher in einer wärmeren Region der Türkei als gerade Ankara zu erwarten wäre. Die Frage der Weibchen von *bernicla* bleibt allerdings ungeklärt.

VERBREITUNG: Türkei, Georgien (Stoeckert 1942, als *alutacea*).

### *Andrena proxima* (Kirby, 1802)

*Melitta proxima* Kirby, 1802: 146-147.

*Andrena proxima* wird sehr häufig in der taxonomischen und faunistischen Literatur erwähnt.

Die einzelnen Meldungen und alte Synonyme sind hier nicht einzeln aufgeführt. Siehe dazu Gusenleitner & Schwarz, 2002: 610-611.

UNTERSUCHTES MATERIAL: Tiere aus Deutschland und Österreich werden nicht einzeln aufgeführt. Hier standen etwa 200 Tiere aus den Sammlungen CS, GRÜ, ZSM u.a. zur Verfügung, außerdem untersuchte D. Doczkal sein mehrere hundert Tiere umfassendes Material aus Baden-Württemberg auf mögliche *alutacea*. FÜRSTENTUM LIECHTENSTEIN: ♀ 13.6.1997 Balzers, Elltal, ein abgeflogenes Tier, zusammen mit einer frischen *alutacea*; ♀ 24.4.1997 Vaduz, Möhliholzrüfi (ETH). ITALIEN: ♀ 20.04.1971 Sizilien, Taormina; ♀ 06.1920 Liguria, Vittoria (GRÜ) – ♀ 20.5.1922 Sizilien Taormina, ♀ Puglia, ♀ 31.5.1993 Mt. Gargano, St. Giovanni, ♀ 16.5.1992 Mt. Gargano, S. Marco (ETH). GRIECHENLAND: ♀ 11.05.1968



Florina; 2 ♀ 13.6.1959 Olymp, Prioni, 1000 m (sehr abgeflogene Tiere, zusammen mit einer frischen *alutacea* (GRÜ) – 2 ♀ 9.5.1976 Nea Agathoupolis / Makedonien (Kraus). UNGARN: ♀ 28.05.1959 Tatatovaros, ♀ 04.06.1957 Roros, Ipoly; ♀ 8.06.1954 Bükk hegys; Hosszuber; Tihany u.a. Fundorte (GRÜ). SCHWEIZ: 2 ♀ 4.6.1997 BE, Lauperswil, Bluttengrat 900 m; ♀ 12.4.1942 GR, Haldenstein; ♀ 6.6.1936 GR, Felsberg; ♀ 8.6.1924 GR, Mundaun; ♀ 27.05.1925 (ETH); TI, Lugano, Mt. Areo (GRÜ)

DIAGNOSE: *Andrena proxima* ist im weiblichen Geschlecht charakterisiert durch die teilweise glänzenden Tergitflächen, die zumindest seitlich auch deutlich punktiert sein können. Alle Tergitendbinden sind in der Mitte breit unterbrochen, das Mesonotum zeigt keine schwarze kurze Unterbehaarung, oder diese ist nur im hinteren Teil schwach ausgeprägt. Siehe auch die Diskussion bei *alutacea*. Die Männchen lassen sich anhand des vollständig chagrinierten Mesonotums, der nur sehr fein und zerstreuten Tergitpunktierung und wie beim Weibchen an den breit unterbrochenen Tergitendbinden erkennen.

VERBREITUNG: *Andrena proxima* ist in Mitteleuropa verbreitet und stellenweise häufig (Verbreitungskarte bei Gusenleitner & Schwarz, 2002). Im Norden erreicht sie Schleswig Holstein und das südliche Dänemark. Außerdem besiedelt sie den Süden von Großbritannien. Ihre Arealausdehnung im Osten ist unbekannt, allerdings scheint sie in Asien (auch in der Türkei) zu fehlen. Ein Tier in der Sammlung GRÜ aus Lettland erwies sich zu *alutacea* gehörend. Im Südwesten erreicht sie Mittel- und wahrscheinlich auch Südfrankreich, allerdings muss hier die Artzugehörigkeit von Belegmaterial zu *ampla* überprüft werden. Italien ist bis Sizilien von *proxima* besiedelt, im Südosten erreicht sie Griechenland und kommt dort zum Teil syntop mit *alutacea* vor.

ÖKOLOGIE: *Andrena proxima* besiedelt vor allem mageres Grünland, aber auch andere trockenwarme Offenstandorte. Die Art ist auf Doldenblütler (Apiaceae) als Pollenquelle spezialisiert (Westrich, 1989). Die Art ist in Deutschland nicht gefährdet.

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## **African biodiversity hotspots: the reptiles of Mt Nlonako, Cameroon**

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### **African biodiversity hotspots: the reptiles of Mt Nlonako, Cameroon. -**

The reptiles of Mt Nlonako, a mountain at the southeastern edge of the Cameroon mountain range ("Dorsale camerounaise"), were inventoried continually over a six year period from 1998 to 2004. This area encompasses 150 km<sup>2</sup> of lowland, submontane and montane rainforest with an elevation up to 1,825 m. Accounts of 89 species are provided based on collected and photo-documented material. This inventory proved Mt Nlonako to be the most species rich single-locality area in reptilian fauna in Africa. With 63 snake species Mt Nlonako exhibits the greatest number of species in Africa and possibly worldwide. Analysis showed the reptilian species composition to be most similar within Cameroon with that of Korup National Park followed by the Dja Faunal Reserve in the south. Relative to the snake composition the Korup NP and the Dimonika region in Congo-Brazzaville show the highest resemblance. In an African context the reptile fauna of Mt Nlonako is characterized by species which occur in both West and Central Africa as opposed to the mountain's amphibian species which more closely resemble Central African fauna. The high species richness and endemism is discussed from a paleoclimatic perspective. Conservation status and threats to the reptiles are noted.

**Keywords:** Amphisbaenia - Crocodylia - Chelonina - Sauria - Serpentes - species richness - endemism - biogeography - conservation.

## **INTRODUCTION**

Despite efforts in surveying the reptile (and amphibian) fauna of the rain forests of tropical central and west Africa (Perret, 1959, 1960, 1961; Leston & Hughes, 1968; Böhme, 1975; Joger, 1982; Trape, 1985; Böhme & Schneider, 1987; Ota *et al.*, 1987;

Trape & Roux-Esteve, 1990; Lawson, 1993; Böhme, 1994a, b; Rödel *et al.*, 1995; Schmitz, 1998; Rödel *et al.*, 1999; Böhme, 2000; Euskirchen *et al.*, 2000; Schmitz *et al.*, 2000; Gossmann *et al.*, 2002; Branch & Rödel, 2003) the knowledge on African rainforest reptile faunas falls behind that of its equivalents in tropical Middle and South America and in tropical Asia (Dunn, 1949; Inger & Colwell, 1977; Murphy *et al.*, 1994). Within the rainforest zones of central and west Africa however, Cameroon, Ghana and Ivory Coast have the best studied reptile faunas (Hughes, 1983; Rödel *et al.*, 1995; LeBreton, 1999; Rödel *et al.*, 1999). Lawson (1993) lists 83 reptile species for the Korup National Park (Korup NP), which makes this one of the most species rich areas for reptiles on the continent. Trape (1975) records 45 snake species from the Dinamika forest site in the People's Democratic Republik of Congo (Congo-Brazzaville).

In Cameroon, the Western and Southwestern Cameroon highlands also known as "Dorsale camerounaise" extending from Mt Cameroon in the south to Tchabal Mbabo in the north are characterized by a high amphibian and reptile species richness and an extraordinary high proportion of endemic species; a veritable hotspot of African herpetofauna diversity (Duellman, 1999; Poynton, 1999; Herrmann *et al.*, 2005).

Contrary to the high biodiversity value of such areas, especially in West and Central Africa, most have no formal conservation status protection (STUART *et al.*, 1990) and are endangered by habitat destruction, mainly by logging activities and human encroachment. Additionally, the natural history of most reptile species from tropical forests in Africa remains unknown. Quantitative ecological studies are entirely lacking with only the first steps taken towards quantitative studies of chameleons (Herrmann & Herrmann, 2005). Ultimately, only a comprehensive understanding of the reptiles of these areas and their natural history will provide the fundamental knowledge for their future survival.

This paper presents a comprehensive reptile species list for Mt Nlonako, which was derived over a period of six years, in which we compile the largest number of reptile species (89), in particular snake species (63), for any single-locality on the African continent.

## STUDY SITES

We surveyed the Mt Nlonako area (Fig. 1) which extends roughly from 4°49'-4°56'N and from 9°56'-10°01'E and encompasses ca. 15,000 ha. The western and northern flanks face the town of Nkongsamba, and the busy road between Douala and Bamenda. The slopes on this side are heavily cultivated with the forest destroyed up to an elevation of approximately 1,100 m. To the south and east however, the forest slopes are much less influenced by human activities. A vast lowland rainforest, encompassing several thousand km<sup>2</sup>, extends from the foothills of Mt Nlonako reaching past Nkondjok in the East and past Yabassi in the South. This area is divided by some unpaved roads and settlements. Logging is or has been carried out in many places within this area. Although hunting pressure is imminent, forest elephants, gorillas, chimpanzees, drills and other large mammals persist. Mt Nlonako itself raises from about 400 m elevation on the southern side to 1,825 m on its peak. The highest and central part of the mountain forms a cuvette, ca. 1.5 km in diameter, with much

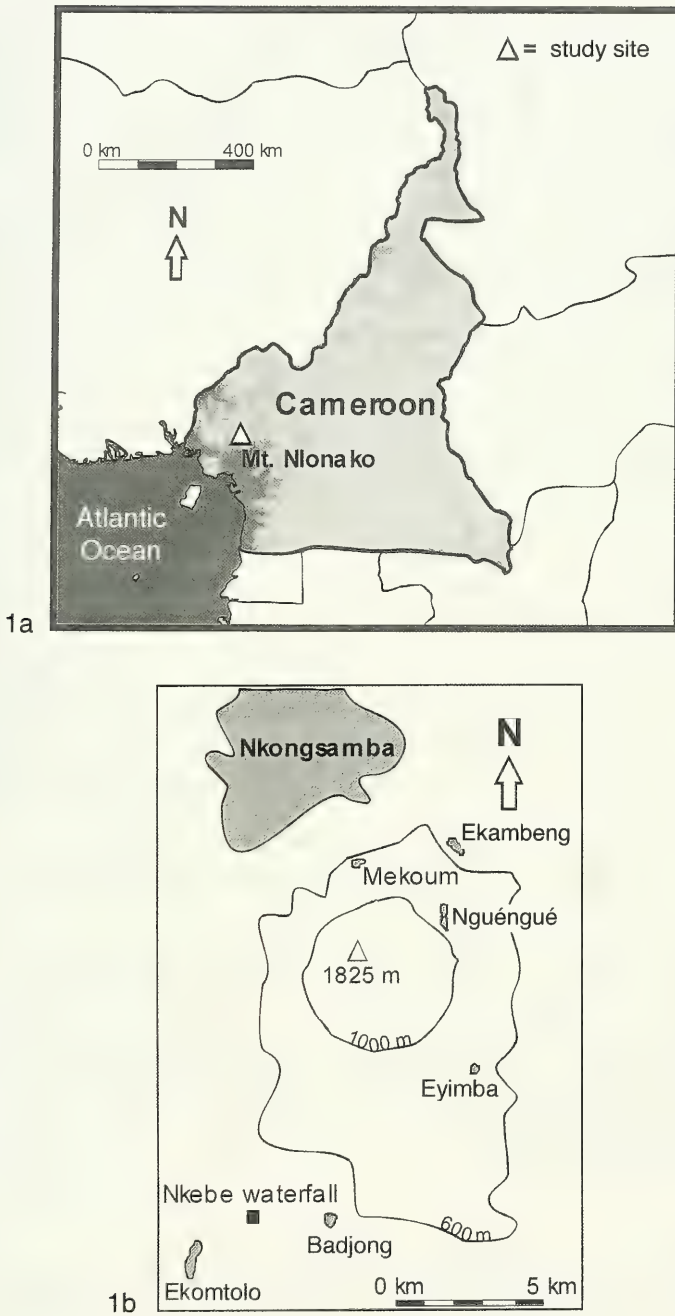


FIG. 1

Survey locations (a) in Cameroon and (b) at Mt Nlonako. Shaded areas are rural communities.



grass/bracken in its center and with forested rims at 1,600 m on the north, east and south sides and the peak on the western side (Dowsett-Lemaire & Dowsett, 1999).

The forest above 1,100 m is pristine with a tall canopy (25–30 m). The forest here seems to be drier and warmer than forests on the close-by Manengouba and Bakossi mountains or Mt Kupe at comparable altitudes. Botanically, Guttiferae (*Allanblackia* sp.) and Burseraceae (*Santiria trimera*) are especially common. Caesalpiniaceae (incl. *Tessmannia anomala*), Ebenaceae (*Diospyros*), Meliaceae, Mimosaceae (*Albizia*), Moraceae, Olacaceae (*Strombosia*), Sapotaceae (incl. *Chrysophyllum albidum*), Steruliaceae (*Cola*) and Apocynaceae (*Tabernaemontana* sp.) are recorded (Dowsett-Lemaire & Dowsett, 1999). Above 1,450 m some rare montane species such as *Polyscias fulva* can be found locally. Many small to medium-sized creeks, often fast flowing and rocky, can be found in the forest. Swamps and pools are rare.

The climate is warm and humid. Over a period of 34 years Nkongsamba (882 m elevation) received an average of 2,762 mm rainfall per year (table 1, Amiet, 1975). During that period the peak dry season extended from December to February with less than 50 mm precipitation per month. The peak rainy season extended from July to September with up to 482 mm precipitation per month. For detailed data on climate and rainfall see Herrmann *et al.* (2005).

Fieldwork initiated in November 1998 and continual sampling extended to June 2004. Sampling occurred in all seasons.

Our survey efforts concentrated on the northern, eastern and southern slopes of Mt Nlonako with the following localities being the main points of collecting:

- Ekambeng (EKA): village at the foot of the northern slopes in the vicinity of Nkongsamba, many coffee plantations, no primary forest
- Mekoum (MEK): village on northern side of the mountain, many coffee plantations, no primary forest
- Nguégué (NGU): village on the rim between northwestern and southeastern slopes, N 4°55'02", E 9°59'21", 1,140 m elevation, some coffee plantations, secondary and predominately primary forest
- Summit (SUM): eastern side of the cuvette, N 4°54'47", E 9°57'93", 1,660 m elevation, rock outcrops, primary montane forest, some areas with grass and bushes
- Eyimba (EYI): very small village on the eastern side of the mountain, N 4°52'92", E 9°59'19", 710 m elevation, small cultivated areas, much primary forest
- Nkebe waterfall (NWF): area between the villages Ekomtolo and Badjong (but also including those two villages), N 4°49'83", E 9°55'49", 470 m elevation, coffee, oil palm and food crop plantations, predominately secondary forest, area with previous and current logging.

## METHODS

### SAMPLING METHODS

We used Y-shaped drift fence/pitfall trap arrays (Corn, 1994) with segments of 5 m length during the initial phase of the project at several localities. Catching success was very low to nil. This method was abandoned after some weeks.

Initially, gluetraps (Bauer & Sadlier, 1992; Glor *et al.*, 2000) which were fixed on tree trunks at about 1.5 m height, were used to sample geckos and other arboreal

reptiles. Only a few skinks (*Trachylepis*) were caught using this method. The abundant ants tended to attack trapped reptiles immediately. This method was abandoned after the first two weeks.

We applied quadrat sampling with 8 x 8 m quadrats (Jaeger & Inger, 1994) at several localities at various elevations. Quadrats worked satisfactorily to gain quantitative data but are work intensive. For the quantitative results see Herrmann *et al.* (2000).

Visual encounter surveys along transects (Crump & Scott, 1994) or opportunistic searches during the day and at night were the dominant methods used. The number of persons surveying varied, but was usually two or three; this method yielded the best success and was carried out throughout the study periods. Acoustic monitoring was also applied but only species represented by at least one voucher specimen are included in the species list. Our data was complemented by donated specimens which were encountered by villagers during their daily movements.

Voucher specimens are deposited in the herpetological collection of the Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn (ZFMK) and in the collection of the senior author (HWH) in the U.S. The latter collection will be transferred to the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). All specimens were either fixed in 10% buffered formaldehyde or 75% ethanol and consecutively preserved in 75% ethanol.

#### BIOGEOGRAPHIC ANALYSIS

To compare the species composition of Mt Nlonako with other areas in West and Central Africa we calculated the "coefficient of biogeographic resemblance" (CBR) after Duellman (1990) with the formula

$$CBR = 2C / (N_1 + N_2)$$

in which C is the number of shared taxa (here species) in two compared areas,  $N_1$  is the number of taxa (here species) in area one and  $N_2$  is the number of taxa (here species) in area two. A CBR value of 0 would mean that Mt Nlonako shares no reptilian species with the compared area, a CBR value of 1 would mean that the species inventory in both areas are identical (Jansen & Köhler, 2002). Jansen and Köhler (2002) excluded ubiquitous species from their analysis arguing that those species are not primary inhabitants of the mountain forest habitats they compared and thus do not bear any information on the biogeographic relationships of those areas. We do not follow this approach for (1) we do not know if ubiquitous species are or are not primary inhabitants of the areas in question, (2) possible "noise" by such species should be similar over the areas analyzed and (3) they are low in number and thus have a limited effect on the analysis.

#### RESULTS

##### *SPECIES ACCOUNT*

In the following we present a systematic list of reptile species encountered during our survey. We list localities and voucher specimens for each taxon. Nomenclature follows Uetz *et al.* (2004), unless otherwise noted. For voucher specimens with no exact locality data we state the locality as Mt Nlonako (MtNL). Otherwise col-

lecting localities are Nkebe waterfall area (NWF), Ekambeng (EKA), Mekoum (MEK), Eyimba (EYI), Nguéngué (NGU) and the Mt Nlonako summit area (SUM). For habitat we differentiate between forest (F) and farmbush (FB). Farmbush are the ecotones between forests and cultivated areas as well as the vicinities of villages and the dirt roads. We also include degenerated secondary forest patches in this category.

## AMPHISBAENIA

### AMPHISBAENIDAE

#### *Monopeltis* sp. (Duméril, 1859)

Locality: EYI. Voucher specimen: ZFMK 68960. Habitat: FB.

Remarks: Only two species, *Monopeltis jugularis* Peters, 1880 and *M. galeata* (Hallowell, 1852) are known from Cameroon. This is the first record of an amphisbaenid from Western Cameroon. Since this specimen is a roadkill in a rather bad conservation state, an identification to the species-level was not possible.

## CROCODYLIA

### CROCODYLIDAE

#### *Osteolaemus tetraspis* Cope, 1861

Locality: NWF, EYI. Voucher specimen: none. Habitat: F.

Remarks: Regularly seen in streams and pools. This species is commonly found as bushmeat in local markets such as in Nkongsamba (see Akani *et al.*, 1998 for the situation in Nigeria). Although under severe hunting pressure, this species seems to occur in stagnant river arms and pools at lower elevations throughout the study area. CITES appendix I.

## CHELONIA

### TESTUDINIDAE

#### *Kinixys erosa* (Schweiger, 1812)

Locality: NGU. Voucher specimen: ZFMK 68982. Habitat: F.

Remarks: Shells of this species can regularly be found in villages where this species is appreciated as bushmeat (Lawson, 2000). CITES appendix II.

#### *Kinixys homeana* Bell, 1827

Locality: NWF. Voucher specimen: none. Habitat: F.

Remarks: Shells of two specimens of this species are kept in the compound of the chief of Ekomtolo. Like *K. erosa*, this species is commonly eaten by local people. CITES appendix II.

## SAURIA

### AGAMIDAE

#### *Agama agama* (Linnaeus, 1758)

Locality: NGU. Voucher specimens: ZFMK 69017, 75376. Habitat: FB.

Remarks: This species was found in all settlements of the study area where it is very abundant in villages and along forest roads. It was never observed in the forest.

## CHAMAELEONIDAE

***Chamaeleo camerunensis* Müller, 1909**

Locality: NWF. Voucher specimen: HWH 20. Habitat: F.

Remarks: Only one ♀ of this species was found and is treated in detail in Harbort & Herrmann (2002). CITES appendix II.

***Chamaeleo cristatus* Stutchbury, 1837**

Localities: MtNL, NWF, EYI, NGU. Voucher specimens: ZFMK 68961, 68980-1, 73063-6, 75146, 75394, HWH 31, 202-4, 617, 816-29, 893-6. Habitat: F, FB.

Remarks: CITES appendix II.

***Chamaeleo montium* Buchholz, 1874**

Locality: MtNL, NGU. Voucher specimens: ZFMK 69117-20, 72855, 73067-74, 73491-5, 75388-93, HWH 208-12, 830-44. Habitat: F, FB.

Remarks: CITES appendix II.

***Chamaeleo oweni* Gray, 1831**

Locality: MtNL, NWF. Voucher specimens: HWH 205-7. Habitat: F, FB.

Remarks: CITES appendix II.

***Chamaeleo pfefferi* Tornier, 1900**

Locality: SUM. Voucher specimens: ZFMK 73490, 74336, HWH 1013. Habitat: F.

Remarks: CITES appendix II.

***Rhampholeon spectrum* (Buchholz, 1874)**

Localities: MtNL, NWF, NGU. Voucher specimens: ZFMK 69101-16, 72853-4, 73075-8, 73496, 75287-95, HWH 16, 194-200, 618, 845-85. Habitat: F.

## GEKKONIDAE

***Hemidactylus intestinalis* Werner, 1897**

Locality: NWF. Voucher specimens: ZFMK 78684, 81713, HWH 213-4, 602. Habitat: F, FB.

Remarks: Henle & Böhme (2003) provide a detailed species account, though using the name *Hemidactylus ansorgii* Boulenger, 1901, which has been shown to be a junior synonym of *H. intestinalis* Werner, 1897 by Perret (1975), and this synonymy has also been mentioned in Kluge (1991).

***Hemidactylus echinus* O'Shaughnessy, 1875**

Locality: NGU. Voucher specimen: ZFMK 69040. Habitat: F, FB.

***Hemidactylus fasciatus* Gray, 1842**

Locality: NWF. Voucher specimen: ZFMK 77893. Habitat: F.

***Hemidactylus mabouia* (Moreau de Jonnès, 1818)**

Locality: NGU. Voucher specimens: ZFMK 69026-39, 75377-9, HWH 1056-7. Habitat: FB.

Remarks: Like *Agama agama*, this species can be found in all human settlement in the study area. It is especially abundant on houses.



***Hemidactylus* sp. indet.**

Locality: NWF. Voucher specimen: ZFMK. Habitat: F, FB.

Remarks: Juvenile specimen which we could identify to species level.

***Lygodactylus conraui* Tornier, 1902**

Locality: EYI. Voucher specimen: ZFMK 68966. Habitat: F, FB.

## LACERTIDAE

***Poromera fordii* (Hallowell, 1857)**

Localities: NWF, NGU. Voucher specimens: ZFMK 69021-5, 78660, 81715, HWH 1058. Habitat: F, FB.

## SCINCIDAE

***Trachylepis affinis* (Gray, 1838)**

Localities: EYI, NGU. Voucher specimens: ZFMK 68962-4, 69062-73, 75383-7. Habitat: FB.

Remarks: Listed as *Mabuya affinis* in Uetz *et al.* (2004). We follow the nomenclature proposed by Bauer (2003) and use the genus name *Trachylepis*. Common in villages, farms and along roads throughout the study area.

***Trachylepis maculilabris* (Gray, 1845)**

Localities: NGU, SUM. Voucher specimens: 69041-61, 69434, 75576-7. Habitat: F, FB.

Remarks: Listed as *Mabuya maculilabris* in Uetz *et al.* (2004). We follow the nomenclature proposed by Bauer (2003) and use the genus name *Trachylepis*. Found in human settlements but also in secondary forest and on rock faces at the summit of Mt Nlonako. Locally abundant.

***Lygosoma fernandi* (Burton, 1836)**

Localities: MtNL, EYI, NGU. Voucher specimens: ZFMK 68959, 69018, 73497, 78026-7, 78814. Habitat: F, FB.

Remarks: In Uetz *et al.* (2004) as *Mochlus fernandi*. We prefer the genus name *Lygosoma* as molecular analyses reveal a closer relationship with this genus (A. S. unpublished results).

***Panaspis breviceps* (Peters, 1873)**

Localities: NWF, NGU. Voucher specimens: ZFMK 69074-85, 72856, 75380, 77889-92, 78700, 78711, HWH 601. Habitat: F.

***Lacertaspis reichenowi* (Peters, 1874)**

Locality: EYI. Voucher specimen: ZFMK 68965. Habitat: F.

Remarks: Listed as *Panaspis reichenowi* in Uetz *et al.* (2004). We follow the nomenclature proposed by Schmitz *et al.* (2005) and use the genus name *Lacertaspis*.

***Lacertaspis rohdei* (Müller, 1910)**

Locality: NGU. Voucher specimens: ZFMK 69086-99, 75382, HWH 1052-5. Habitat: F.

Remarks: Listed as *Panaspis rohdei* in Uetz *et al.* (2004). We follow the nomenclature proposed by Schmitz *et al.* (2005) and use the genus name *Lacertaspis*.

***Leptosiaphos vigintiserierum* (Sjöstedt, 1897)**

Localities: NGU, SUM. Voucher specimens: ZFMK 69426-32, 69549. Habitat: F.

***Leptosiaphos* spp.**

Locality: NGU. Voucher specimens: ZFMK 69529-31, 69550-4, 75381. Habitat: F.

Remarks: Our material of hitherto undescribed or unidentifiable *Leptosiaphos* includes five morphologically distinct groups. One group resembles *L. pauliani* (Angel, 1940) (Fig. 2) from the Bamboutos Mtns, Cameroon, another *L. vigintiserierum* (Fig. 3).

**VARANIDAE**

***Varanus ornatus* (Daudin, 1803)**

Localities: MtNL, NWF, NGU. Voucher specimens: ZFMK 69016, HWH 18, 982. Habitat: F, FB.

Remarks: A common species which is often found as bushmeat in villages and local markets. Large specimens sometimes are encountered in snare traps. CITES appendix II.

**SERPENTES**

**TYPHLOPIDAE**

***Typhlops angolensis* (Bocage, 1866)**

Localities: EKA, NGU. Voucher specimens: ZFMK 75126, 75178-9. Habitat: FB.

***Typhlops congestus* (Duméril & Bibron, 1844)**

Locality: MtNL. Voucher specimens: ZFMK 77642, 78132-6, 78819-24, HWH 587. Habitat: FB.

***Typhlops lineolatus* Jan, 1864**

Locality: MtNL. Voucher specimens: HWH 588, 695. Habitat: FB.

***Typhlops punctatus* (Leach in Bowdich, 1819)**

Locality: MtNL. Voucher specimens: ZFMK 78815-8. Habitat: FB.

**BOIDAE**

***Calabaria reinhardtii* (Schlegel, 1848)**

Localities: MtNL, NGU. Voucher specimens: ZFMK 75780, HWH 690-1, 808-15, 897-901, 1009. Habitat: F, FB.

Remarks: This is one of the most abundant snakes in the area. Often found crossing roads or dead on the road (DOR). The species was observed in many different localities in the study area. CITES appendix II.

***Python sebae* (Gmelin, 1789)**

Locality: MtNL. Voucher specimens: HWH 890-1. Habitat: F, FB.



FIGS 2-3

2. *Leptosiaphos* sp. cf. *pauliani* from the forest above Nguéngué. 3. *Leptosiaphos* sp. cf. *vigintiserierum* from the forest above Nguéngué.

Remarks: This species is probably restricted to the lower elevations of the study area. People of NGU for example did not confirm the existence of the species in their area. On one occasion, villagers of Ekomtolo were observed preparing a medium sized *P. sebae* for consumption. The species is well known to the people of Ekomtolo and Badjong. It is not common. CITES appendix II.

## COLUBRIDAE

***Afronatrix anoscopus*** (Cope, 1861)

Locality: MtNL, NWF. Voucher specimens: ZFMK 81716, HWH 400, 753.  
Habitat: F, FB.

***Boiga blandingii*** (Hallowell, 1844)

Localities: MtNL, NWF, NGU. Voucher specimens: ZFMK 68987, 75119, 75175-7, 75857-8, HWH 681, 749-51. Habitat: F, FB.

***Boiga pulverulenta*** (Fischer, 1856)

Localities: MtNL, NWF, EYI, NGU. Voucher specimens: ZFMK 75155-7, 77913-4, 78085, 78852-6, 81717, HWH 423-32. Habitat: F, FB.

***Bothrophthalmus brunneus*** (Günther, 1863)

Locality: MtNL, NWF. Voucher specimens: ZFMK 75121, 78839, HWH 418, 450. Habitat: F.

Remarks: The former *B. lineatus* subspecies *brunneus* is considered to be a full species by Hughes (2000) and Gossmann *et al.* (2002).

***Chamaelycus fasciatus*** (Günther, 1858)

Localities: MtNL, NWF, EKA, MEK, EYI, NGU, SUM. Voucher specimens: ZFMK 69002, 69433, 75224-32, 77631, 77663, 78103, 78845-6, HWH 407-17, 633. Habitat: F.

***Dasypeltis fasciata*** Smith, 1849

Locality: MtNL. Voucher specimens: HWH 404-5. Habitat: F, FB.

***Dasypeltis scabra*** (Linnaeus, 1758)

Localities: MtNL, NGU. Voucher specimens: ZFMK 78118-9, 78864-7.  
Habitat: F, FB.

***Dipsadoboa duchesnei*** (Boulenger, 1901)

Locality: MtNL, NWF. Voucher specimens: ZFMK 81718, HWH 435-7, 715.  
Habitat: F.

***Dipsadoboa underwoodi*** Rasmussen, 1993

Locality: NWF. Voucher specimen: ZFMK 81719. Habitat: F.

***Dipsadoboa unicolor*** Günther, 1858

Localities: MtNL, NGU. Voucher specimens: ZFMK 75266-7, HWH 438, 716.  
Habitat: F.

***Dipsadoboa viridis*** (Peters, 1869)

Locality: MtNL. Voucher specimens: ZFMK 78862-3, 79031, HWH 433-4, 717, 759-64. Habitat: F.

***Dipsadoboa weileri*** (Lindholm, 1905)

Localities: MtNL, NGU. Voucher specimens: ZFMK 75340, 78121-2, HWH 439-40. Habitat: F.



***Gastropyxis smaragdina* (Schlegel, 1837)**

Localities: MtNL, NWF, EKA, MEK, EYI, NGU. Voucher specimens: ZFMK 68975, 68989-91, 75134, 75152-4, 75262-4, 77657-60, 77906, 78077, 78093-4, 79029-30, HWH 399, 626, 802. Habitat: F, FB.

***Gonionotophis brussauxi* (Mocquard, 1889)**

Localities: MtNL, NWF, EYI. Voucher specimens: ZFMK 77636, 77915, 78850-1. Habitat: F.

***Grayia caesar* (Günther, 1863)**

Locality: NGU. Voucher specimen: ZFMK 78120. Habitat: F.

***Grayia smythii* (Leach, 1818)**

Locality: NWF. Voucher specimen: HWH 1208. Habitat: F, FB.

***Hapsidophrys lineatus* Fischer, 1856**

Localities: MtNL, NWF, NGU. Voucher specimens: ZFMK 75125, 75265, 75373, 78078-9, 79022-8, HWH 387-93, 803-6. Habitat: F, FB.

***Hormonotus modestus* (Duméril, Bibron & Duméril, 1854)**

Locality: MtNL. Voucher specimens: ZFMK 78859-61. Habitat: F.

***Hydraethiops melanogaster* Günther, 1872**

Locality: MtNL. Voucher specimens: ZFMK 72729, HWH 694, 752. Habitat: F.

***Lamprophis fuliginosus-lineatus-complex***

Thorpe & McCarthy (1978) state, that the two species *L. fuliginosus* and *L. lineatus* are difficult to differentiate in some areas. Our material allowed the assignment of specimens to either of the two species.

***Lamprophis fuliginosus* (Boie, 1827)**

Locality: NGU. Voucher specimens: ZFMK 69010-5, 78219. Habitat: F, FB.

***Lamprophis lineatus* Duméril, Bibron & Duméril, 1854**

Localities: MtNL, NWF, NGU. Voucher specimens: HWH 441-9, 628-30, 702-9, 778-94, 965-74, 976, 1008, 1163. Habitat: F, FB.

***Lamprophis olivaceus* (Duméril, 1856)**

Localities: MtNL, NWF, MEK, NGU. Voucher specimens: ZFMK 68976, 75122, 75240, 75343, 77920, 79037-9, HWH 590, 981. Habitat: F, FB.

***Lamprophis virgatus* (Hallowell, 1854)**

Localities: MtNL, NWF, EKA, MEK, EYI, NGU. Voucher specimens: ZFMK 68977, 69007-9, 75116-8, 75138-45, 75147-51, 75344-71, 77637-8, 77662, 77921-2, 78203-18, 79040-66.

***Lycophidion laterale* Hallowell, 1857**

Localities: MtNL, NGU. Voucher specimens: ZFMK 69398, 75233-5, 75374, 78080-1, 78843-4, HWH 406, 754-5. Habitat: F.

***Mehelya guirali* (Mocquard, 1887)**

Localities: MtNL, NWF, EYI, NGU. Voucher specimens: ZFMK 69001, 75169-74, 75270, 77909, 78082-4, 78092, 78830-2. Habitat: F, FB.

***Mehelya poensis* (Smith, 1847)**

Localities: MtNL, NWF, EYI, NGU. Voucher specimens: ZFMK 75268, 77910-2, 78825, 78827-9, HWH 419, 616, 713, 756-8. Habitat: F, FB.

***Mehelya riggenbachii*** (Sternfeld, 1910)

Localities: MtNL, NWF. Voucher specimens: HWH 420, 631, 718. Habitat: F.

***Mehelya stenophthalmus*** (Mocquard, 1887)

Localities: MtNL, NWF, NGU. Voucher specimens: ZFMK 75269, 78131, 78826, HWH 632, 984. Habitat: F, FB.

***Natriciteres fuliginoides*** (Günther, 1858)

Localities: MtNL, NWF, EKA, EYI, NGU. Voucher specimens: 75220, 77643-56, 77916-7, 78104, 78178-202, 78985-79003, HWH 451-74, 610-1, 613-4, 696-8, 701, 767-74, 942-58, 1010. Habitat: F, FB.

***Natriciteres olivacea*** (Peters, 1854)

Localities: MtNL, MEK, NGU. Voucher specimens: ZFMK 68974, 68992, 68997-9, 75201-19, 75341-2, 75372, 78979. Habitat: F, FB.

***Natriciteres variegata*** (Peters, 1861)

Localities: MtNL, NWF, NGU. Voucher specimens: ZFMK 68993-6, 75180-200, 77918-9, 78095, 78173-7, 78980-4, HWH 475-89, 698-700, 776-7, 959-64. Habitat: F, FB.

***Philothamnus carinatus*** (Andersson, 1901)

Localities: MtNL, MEK, NGU. Voucher specimens: ZFMK 75236-9, 75339, 78127, 79032-6, HWH 634-6, 712, 798, 985. Habitat: F.

Remarks: In Uetz *et al.* (2004) not listed for Cameroon and in LeBreton (1999) as a subspecies of *heterodermus*.

***Philothamnus heterodermus*** (Hallowell, 1857)

Localities: MtNL, EYI, NGU. Voucher specimens: ZFMK 77632-5, 78123-6, HWH 710-1, 795-7, 807. Habitat: F, FB.

***Philothamnus nitidus*** (Günther, 1863)

Locality: MtNL. Voucher specimen: HWH 637. Habitat: F.

***Poecilipholis cameroneis*** Boulenger, 1903

Locality: MtNL. Voucher specimen: HWH 589. Habitat: F.

***Rhamnophis aethiopissa*** Günther, 1862

Locality: NGU. Voucher specimen: ZFMK 68979. Habitat: F, FB.

***Rhamnophis batesii*** (Boulenger, 1908)

Localities: MtNL, NWF, EKA, NGU. Voucher specimens: ZFMK 75334, 77661, 78105-10, 78833-8, 79067, HWH 401-2, 627. Habitat: F.

***Thelotornis kirtlandii*** (Hallowell, 1844)

Localities: MtNL, NWF, EKA, EYI, NGU. Voucher specimens: ZFMK 68988, 75271-5, 77664, 78073-4, 78871-9, HWH 421-2, 615, 625, 680, 975, 1006-7. Habitat: F, FB.

***Thrasops flavigularis*** (Hallowell, 1852)

Localities: MtNL, NGU. Voucher specimens: ZFMK 78032-3, 78840-2, HWH 403. Habitat: F, FB.

## ATRACTASPIDIDAE

***Aparallactus modestus* (Günther, 1859)**

Localities: NWF, EYI, MEK, NGU. Voucher specimens: ZFMK 68978, 69003-6, 75123-4, 75241-60, 75335, 75337-8, 77640-1, 77907-8, 78150-72, 79006-21, 79221-2, HWH 640-9, 977-80, 1011-2. Habitat: F, FB.

***Aparallactus niger* Boulenger, 1897**

Locality: MtNL. Voucher specimen: ZFMK 79005. Habitat: F.

Remarks: The specimen possesses a single prefrontal with the nasals in broad contact. This specimen represents the first record of this species for Cameroon.

***Atractaspis aterrima* Günther, 1863**

Locality: MtNL. Voucher specimen: HWH 766. Habitat: F, FB.

***Atractaspis boulengeri* Mocquard, 1897**

Locality: EKA. Voucher specimen: ZFMK 75136. Habitat: F.

***Atractaspis irregularis* (Reinhardt, 1843)**

Locality: EKA. Voucher specimen: ZFMK 75137. Habitat: F, FB.

***Atractaspis reticulata* Sjöstedt, 1896**

Localities: MtNL, NGU. Voucher specimens: ZFMK 75261, HWH 639, 714, 765. Habitat: F.

***Polemon collaris* (Peters, 1881)**

Localities: MtNL, NGU. Voucher specimens: ZFMK 69000, 75221-3, 78137-49, 78847-9, HWH 364-5, 693. Habitat: F.

***Polemon gabonensis* (Duméril, 1856)**

Locality: NWF. Voucher specimen: ZFMK 75120. Habitat: F.

***Polemon gracilis* (Boulenger, 1911)**

Locality: NGU. Voucher specimen: ZFMK 78129. Habitat: F.

Remarks: This is the first voucher specimen from Cameroon.

***Polemon notatus* (Peters, 1882)**

Localities: NWF, EYI, NGU. Voucher specimens: ZFMK 77905, 78128, HWH 17. Habitat: F.

## ELAPIDAE

***Dendroaspis jamesoni jamesoni* (Traill, 1843)**

Localities: MtNL, NWF, EKA, EYI, NGU. Voucher specimens: ZFMK 68957, 75276, 75336, 77672-4, 77898, 78096-102, 78887-95, HWH 380-2, 719-24, 996-8. Habitat: F, FB.

***Naja melanoleuca* Hallowell, 1857**

Localities: MtNL, NWF, EKA, EYI, NGU. Voucher specimens: ZFMK 68985-6, 69019-20, 75127-33, 75158-62, 75277-84, 75793, 77630, 77667-71, 77900-4, 78034-53, 78947-78, 79004, HWH 384-6, 604-5, 612, 619-22, 676-9, 727-36, 889, 925-41, 1000-5. Habitat: F, FB.

Remarks: In the study area this is the most abundant snake in villages where specimens are often attracted by poultry.

***Pseudohaje goldii*** (Boulenger, 1895)

Localities: MtNL, NWF, EKA, EYI, NGU. Voucher specimens: ZFMK 68984, 69598, 75163, 77629, 77665-6, 77897, 78028-31, 78880-6, HWH 370-9, 682-4, 725-6, 999. Habitat: F, FB.

## VIPERIDAE

***Atheris squamigera*** (Hallowell, 1854)

Localities: MtNL, EYI, NGU. Voucher specimens: ZFMK 75285-6, 77622-3, 78111-7, 78868-70, HWH 394-5, 692, 1183. Habitat: F.

***Causus lichtensteinii*** (Jan, 1859)

Localities: MtNL, EYI, NGU. Voucher specimens: ZFMK 68959, 75164, 77624-8, 78075-6, 78896-901, HWH 396-8, 607-9. Habitat: F, FB.

***Causus maculatus*** (Hallowell, 1842)

Localities: MtNL, NWF, EKA. Voucher specimens: ZFMK 75135, 77899, 78902, HWH 687-9, 740-8. Habitat: F, FB.

***Bitis gabonica*** (Duméril, Bibron & Duméril, 1854)

Localities: MtNL, NWF, EYI, NGU. Voucher specimens: ZFMK 68983, 75168, 75331-3, 77894-6, 78070, 78086-91, 78903-9, HWH 367-9, 888, 902, 993-5. Habitat: F, FB.

***Bitis nasicornis*** (Shaw, 1802)

Localities: MtNL, NWF, EYI, NGU. Voucher specimens: ZFMK 75165-7, 75296-330, 75375, 77617-21, 78054-69, 78071-2, 78130, 78910-46, HWH 366, 606, 623-4, 685-6, 737-9, 903-24, 987-92. Habitat: F, FB.

## DISCUSSION

We recorded a total of 89 reptile species from Mt Nlonako (table 1 and 3). Thirty-six percent of all 249 reptile species (excluding sea turtles) and 42 percent of the 151 snake species recorded for Cameroon (LeBreton, 1999) occur at Mt Nlonako. Thus Mt Nlonako hosts the most species rich single-locality reptile and especially snake fauna in Africa (Böhme, 2000). For snakes Mt Nlonako at this stage possibly represents the most species rich single-locality in the world. The subsequent area of reptile species richness is represented by Korup NP approximately 130 km W of Mt Nlonako with 83 reptile species (Lawson, 1993). This is followed by the Dja Faunal Reserve in Cameroon (80 species, LeBreton, 1999). Relative to snakes Mt Nlonako is again followed by the Korup NP (55 species), Mt Nimba in Guinea (52 species, Ineich, 2003), the Dja Faunal Reserve (49 species, LeBreton, 1999), the Dimonika forest site in Congo-Brazzaville (45 species, Trape, 1975), the Comoe NP in Ivory Coast (44 species, Rödel 1995 and 1999), the Ziam Forest in Guinea (41 species, Böhme, 2000) and 40 species found in the Taï NP in Ivory Coast (Rödel & Mahsberg, 2000; Ernst & Rödel, 2002). Four snake species assemblages, reported from Ivory Coast, Ghana, Gabon and the Central African Republic, ranged between 35 and 39 species (Böhme, 2000). These results may not only represent the actual pattern of snake species richness in the rainforest areas of West and Central Africa but may also indicate survey activities and gaps as many areas with a very high potential for exceptional species richness have not been sampled adequately.



TABLE 1. Reptile species richness of three different rainforest areas in southwestern and southern Cameroon. Numbers in parentheses are the number of species directly recorded by the authors for the areas. NP = National Park; FR = Faunal Reserve. From LeBreton's list only species found or mentioned from the Dja FR or adjacent areas were included in this analysis.

	Mt Nlonako	Korup NP	Dja FR
area in km <sup>2</sup>	150	1,240	8,400
reptile species	89	83 (69)	80 (14)
reptile species/km <sup>2</sup>	0.59	0.07	0.01
snake species	63	55 (41)	49 (10)
snake species/km <sup>2</sup>	0.42	0.04	0.01
source	this study	Lawson, 1993	LeBreton, 1999

TABLE 2. West and Central African rainforest reptile and snake faunas and their relationships with the Mt Nlonako reptile and snake fauna.

country	locality	reptile species	CBR	snake species	CBR	source
Cameroon	Korup National Park	83	0.65	55	0.72	Lawson, 1993
Congo (RC)	Dimonika region	-	-	45	0.70	Trape, 1985
Cameroon	Dja Faunal Reserve	80	0.60	49	0.66	LeBreton, 1999
Guinea, Ivory Coast, Liberia	Mt Nimba	69	0.51	52	0.57	Ineich, 2003
Gabon	Mounts de Cristal	48	0.54	32	0.55	Pauwels <i>et al.</i> , 2002
Gabon	Massif du Chaillu	46	0.47	29	0.50	Pauwels <i>et al.</i> , 2002
Guinea	Zima forest	46	0.43	41	0.50	Böhme, 2000
Ivory Coast	Tai NP	-	-	40	0.50	Rödel & Mahsberg, 2000, Ernst & Rödel, 2002
Cameroon	Mt Kupe & Bakossi Mtns	38	0.47	18	0.35	Schmitz, 1998
Ivory Coast	Haute Dodo	17	0.23	9	0.19	Branch & Rödel, 2003

Within Cameroon, our data shows not only the highest species richness for a single locality, but also the highest number of species per area (km<sup>2</sup>) as presented in table 1.

Of the 89 species recorded for Mt Nlonako, one species is an amphisbaenid (1%), one is a crocodile (1%) and two are tortoises (2%). Of the 22 lizard species (25%) one is an agamid (5%), one a lacertid (5%), one a varanid (5%), five are geckos (23%), six are chamelons (26%), and eight skinks (36%). The 63 snake species (71%) include two boids (3%), three elapids (5%), four typhlopids (6%), five vipers (8%), ten atractaspids (16%), and 39 colubrids (62 %). The lizard fauna appears depauperated compared to lizard faunas in arid or semiarid African environments. However, similar findings are presented by Böhme (2000) for the Zima Forest in Guinea and Branch & Rödel (2003) for areas in western Ivory Coast.

TABLE 3. Abundance, altitudinal distribution at Mt Nlonako and zoogeographic distribution in Africa of reptile species from Mt Nlonako.

taxa	abundance <sup>1</sup>	500m	altitudinal distribution <sup>2</sup>	1,100m	1,700m	CE	zoogeographic distribution <sup>3</sup>		
			700m	1,100m	1,700m		WA	CA	SSA
<b>AMPHISBAENIA</b>									
AMPHISBAENIDAE									
<i>Monopeltis</i> sp.	+		—					+	
<b>CROCODYLIA</b>									
CROCODYLIDAE									
<i>Osteolaemus tetraspis</i>	+	—	—				+	+	
<b>CHELONIA</b>									
TESTUDINIDAE									
<i>Kinixys erosa</i>	+			—				+	
<i>Kinixys homeana</i>	+	—					+	+	
<b>SAURIA</b>									
AGAMIDAE									
<i>Agama agama</i>	+++	—	—	—					+
CHAMAELEONIDAE									
<i>Chamaeleo camerunensis</i>	+	—	—	—		+			
<i>Chamaeleo cristatus</i>	+++	—	—	—				+	
<i>Chamaeleo montium</i>	+++	—	—	—		+			
<i>Chamaeleo oweni</i>	+	—	—	—				+	
<i>Chamaeleo pfefferi</i>	++	—	—	—	—	+			
<i>Rhampholeon spectrum</i>	+++	—	—	—				+	
GEKKONIDAE									
<i>Hemidactylus intestinalis</i>	++	—	—	—					
<i>Hemidactylus echinus</i>	+	—	—	—			+	+	
<i>Hemidactylus fasciatus</i>	+	—	—	—			+	+	
<i>Hemidactylus mabouia</i>	+++	—	—	—					+
<i>Lygodactylus conraui</i>	+	—	—	—			+	+	
LACERTIDAE									
<i>Poromera fordii</i>	++	—	—	—				+	
SCINDIDAE									
<i>Trachylepis affinis</i>	+++	—	—	—	—		+	+	
<i>Trachylepis maculabris</i>	+++	—	—	—	—				+
<i>Lygosoma fernandi</i>	++	—	—	—	—		+	+	

taxa	abundance <sup>1</sup>	altitudinal distribution <sup>2</sup>			1,700m	CE	zoogeographic distribution <sup>3</sup>		
		500m	700m	1,100m			WA	CA	SSA
<i>Panaspis breviceps</i>	++	—	—	—				+	
<i>Lacertaspis reichenowii</i>	+	—	—	—				+	
<i>Lacertaspis rohdei</i>	++	—	—	—				+	
<i>Leptosiaphos vigintiserierum</i>	+	—	—	—	—	+			
<i>Leptosiaphos</i> spp.	+	—	—	—	—	+			
VARANIDAE									
<i>Varanus ornatus</i>	+++	—	—	—			+	+	
SERPENTES									
TYPHLOPIDAE									
<i>Typhlops angolensis</i>	+	—	—	—				+	
<i>Typhlops congestus</i>	++	—	—	—				+	
<i>Typhlops lineolatus</i>	+	?	?	?			+	+	
<i>Typhlops punctatus</i>	+	?	?	?			+	+	
BOIDAE									
<i>Catabaria rheinhardtii</i>	+++	—	—	—			+	+	
<i>Python sebae</i>	+	—	—	—			+	+	
COLUBRIDAE									
<i>Afonatrix anoscopus</i>	+	?	?	?			+	+	
<i>Boiga blandingii</i>	++	—	—	—			+	+	
<i>Boiga pulverulenta</i>	+++	—	—	—			+	+	
<i>Bothrophthalmus brunneus</i>	+	—	—	—			+	+	
<i>Chamaelycus fasciatus</i>	++	—	—	—	—		+	+	
<i>Dasypeltis fasciata</i>	+	?	?	?			+	+	
<i>Dasypeltis scabra</i>	+	—	—	—					+
<i>Dipsadoboa duchesnei</i>	++	?	?	?			+	+	
<i>Dipsadoboa underwoodi</i>	+	—	—	—			+	+	
<i>Dipsadoboa unicolor</i>	++	?	?	?			+	+	
<i>Dipsadoboa viridis</i>	++	—	—	—			+	+	
<i>Dipsadoboa weileri</i>	++	—	—	—			+	+	
<i>Gastrophysus smaragdina</i>	+++	—	—	—			+	+	
<i>Gonionotophis brussaaxi</i>	+	—	—	—			+	+	
<i>Grayia caesar</i>	+	—	—	—				+	

taxa	abundance <sup>1</sup>	altitudinal distribution <sup>2</sup>			CE	zoogeographic distribution <sup>3</sup>		
		500m	700m	1,100m		WA	CA	SSA
<i>Grayia smythii</i>	+	—	—	—		+	+	
<i>Hapstodiphris lineatus</i>	+++	—	?	—		+	+	
<i>Hormonotus modestus</i>	+	?	?	?		+	+	
<i>Hydraethiops melanogaster</i>	+	?	?	?			+	
<i>Lamprophis fuliginosus</i>	++	—	—	—				+
<i>Lamprophis lineatus</i>	+++	—	—	—		+	+	
<i>Lamprophis olivaceus</i>	++	—	—	—		+	+	
<i>Lamprophis virgatus</i>	+++	—	—	—		+	+	
<i>Lycophidion laterale</i>	++	—	—	—		+	+	
<i>Mehelya guirali</i>	++	—	—	—		+	+	
<i>Mehelya poensis</i>	++	—	—	—		+	+	
<i>Mehelya riggenbachi</i>	+	—	—	—	+			
<i>Mehelya stenophthalmus</i>	++	—	—	—		+	+	
<i>Natriciteres fuliginoides</i>	+++	—	—	—		+	+	
<i>Natriciteres olivacea</i>	+++	—	—	—				+
<i>Natriciteres variegata</i>	+++	—	—	—				+
<i>Philothamnus carinatus</i>	+++	—	—	—		+	+	
<i>Philothamnus heterodermus</i>	++	—	—	—		+	+	
<i>Philothamnus nitidus</i>	+	?	?	?		+	+	
<i>Poecilipholis camerounensis</i>	+	?	?	?	+			
<i>Rhamnophis aethiopiassa</i>	+	—	—	—		+	+	
<i>Rhamnophis batesii</i>	++	—	—	—		+	+	
<i>Thelotornis kirtlandii</i>	+++	—	—	—		+	+	
<i>Thrasops flavigularis</i>	++	—	—	—		+	+	
ATRACASPIDIDAE								
<i>Aparallactis modestus</i>	+++	—	—	—		+	+	
<i>Aparallactis niger</i>	+	?	?	?		+	+	
<i>Atractaspis aterrima</i>	+	?	?	?		+	+	
<i>Atractaspis boulengeri</i>	+	—	—	—			+	
<i>Atractaspis irregularis</i>	+	—	—	—		+	+	
<i>Atractaspis reticulata</i>	+	—	—	—			+	
<i>Polemon collaris</i>	+++	—	—	—			+	



taxa	abundance <sup>1</sup>	altitudinal distribution <sup>2</sup>			1,700m	CE	zoogeographic distribution <sup>3</sup>		
		500m	700m	1,100m			WA	CA	SSA
<i>Polemon gabonensis</i>	+	—	—	—			+	+	
<i>Polemon gracilis</i>	+	—	—	—		+			
<i>Polemon notatus</i>	+	—	—	—				+	
ELAPIDAE									
<i>Dendroaspis jamesoni jamesoni</i>	+++	—	—	—			+	+	
<i>Naja melanoleuca</i>	+++	—	—	—					+
<i>Pseudohaje goldii</i>	+++	—	—	—				+	
VIPERIDAE									
<i>Atheris squamigera</i>	++	—	—	—			+	+	
<i>Causus lichtensteini</i>	++	—	—	—			+	+	
<i>Causus maculatus</i>	++	—	—	—			+	+	
<i>Bitis gabonica</i>	+++	—	—	—			+	+	
<i>Bitis nasicornis</i>	+++	—	—	—			+	+	

<sup>1</sup>based on voucher specimens and observations, + = rare, ++ = moderately abundant, +++ = abundant; <sup>2</sup>based on voucher specimens and observations, elevation in meters corresponds to the major study sites; <sup>3</sup>based on Uetz et al., 2002, CE = Cameroon endemic, WA = West Africa, CA = Central Africa, SSA = Sub-Saharan Africa.

The distribution of species along an elevational gradient shows that most species are found at lower elevations (table 3). Only a few species can be considered purely montane such as *Chamaeleo pfefferi* and three skink species (*Lacertaspis rohdei*, *Leptosiaphos vigintiserierum*, *Leptosiaphos* spp.).

In a broader biogeographic context, 51 of the reptile species of Mt Nlonako can be considered West / Central African in distribution (table 3). Only two species have a pure West African distribution, of which one, *Aparallactus niger* is recorded here for the first time in Cameroon and Central Africa and had its eastern distribution border in Ivory Coast. Twenty-one are distributed in Central Africa only. Ten of the recorded species are endemic to Cameroon. Eight species, *Agama agama*, *Hemidactylus mabouia*, *Trachylepis maculilabris*, *Dasyplepis scabra*, *Lamprophis fuliginosus*, *Natriciteres olivaceus* and *N. variegata*, and *Naja melanoleuca* have a wider distribution in Sub-Saharan Africa.

Overall, Mt Nlonako is dominated by a West / Central African reptile fauna. This is supported by the relatively high coefficient of biogeographic resemblance (CBR) as demonstrated in table 2. This is different to the biogeographic relationships of the amphibian fauna which showed closer relations to the Central African amphibian fauna as compared to the west African amphibian fauna (Herrmann *et al.*, 2005). Here, the reptile faunas of the southwest Cameroonian Korup NP and the south Cameroonian Dja Faunal Reserve show a high degree of resemblance. As for snakes the CBR's exhibited by the Korup NP, the Dimonika region in Congo-Brazzaville, the Dja Faunal Reserve and Mt Nimba in West Africa indicate the highest resemblance.

The exceptional species richness and high degree of endemism in lizards of Mt Nlonako and the West Cameroonian mountain range can be explained by palaeogeographic events. Historically this area has served as a refuge during drastic climate fluctuations. During the Pleistocene circa 20,000 years ago, African wet forests were restricted to a few isolated areas (Livingstone, 1982). Those fluctuations and refuges played an important role in the evolution of the high number of (endemic) reptile species as Lawson (1993) also describes for the Korup NP.

*Osteolaemus tetraspis*, *Kinixys erosa* and *K. homeana*, all five *Chamaeleo* species, *Varanus ornatus*, *Calabaria reinhardtii* and *Python sebae* are listed in CITES appendices for which international trade is regulated. The only species listed as threatened is *Osteolaemus tetraspis* (vulnerable, IUCN 2003). Akani *et al.* (1998) provide further insight into the local trade and consumption of this species in Nigeria; the situation in Cameroon can be considered very similar. The two tortoise species *Kinixys erosa* and *homeana* are listed as data deficient by the IUCN (2003). Lawson (2000) provides data on their conservation status in Cameroon. *Osteolaemus tetraspis*, *Python sebae* and *Naja melanoleuca* are protected by Cameroonian law. Threats to the Mt Nlonako reptile fauna are (1) habitat destruction by logging in the eastern and southern parts of the area, (2) habitat destruction by human encroachment as notable on the northern and western slopes of Mt Nlonako adjacent to the town Nkongsamba and (3) the hunting and consumption as food of species like *Osteolaemus tetraspis*, the two *Kinixys* species and *Python sebae*.

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